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WOOSTER, OHIO, U. S. A.

The native forest at the Experiment Station, a part of the forest arboretum

RAW VERSUS PASTEURIZED MILK

I. ANEMIA DEVELOPMENT, GROWTH, AND CALCIFICATION

W. E. KRAUSS, J. H. ERB,[1] AND R. G. WASHBURN

There is still some dispute as to the effect of pasteurization on the nutritive value of milk. Due to this and to the fact that work has been carried on in this laboratory for several years on the production of nutritional anemia on exclusive raw milk diets, it was thought advisable to determine whether any difference existed in the rate of anemia development on raw or pasteurized milk.

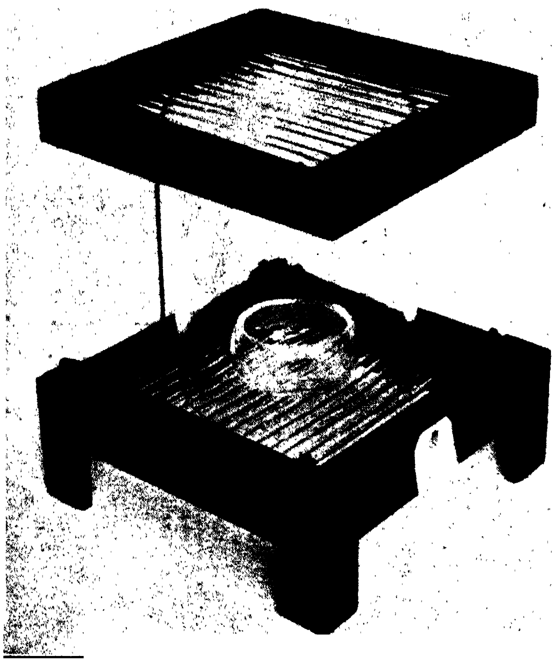

Fig. 1.—One type of glass cage used

The paired feeding method was used in this work, one rat of each pair receiving raw milk exclusively and the other pasteurized milk exclusively. The milk used was obtained from cows fed a good dairy ration consisting of alfalfa hay, corn silage, corn, oats, bran, and linseed oilmeal. Half of the milk was pasteurized in glass, under laboratory conditions. To avoid metallic contamination, the milk was collected in enameled buckets and stored in glass bottles, from which it was transferred to glass feeding dishes by

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means of pipettes. The rats were housed individually in glass cages (Figs. 1 and 2).

Twenty-three pairs of rats were used in this experiment. Chart 1 gives the growth, hemoglobin, and red cell curves for three typical pairs. This chart shows that very little difference existed in the rate of anemia development on raw or pasteurized milk (held at 62.5° C. for 30 minutes).

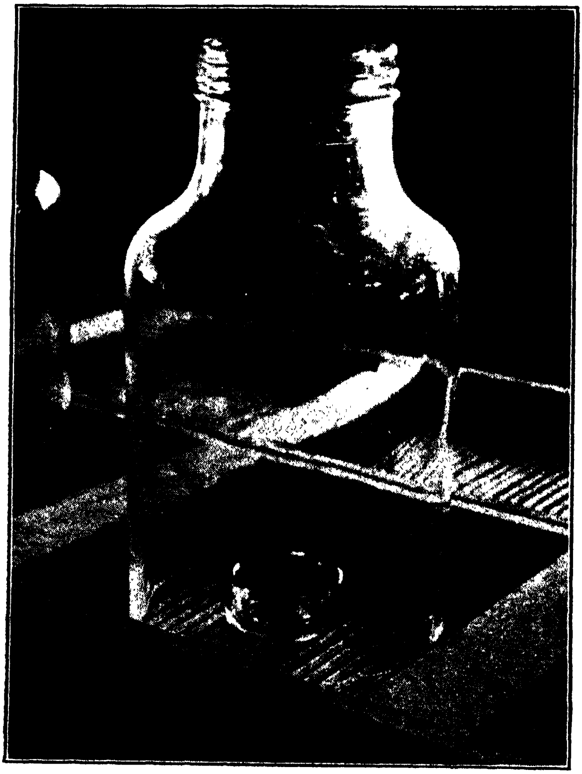

Fig. 2.—Another type of glass cage used

To obtain information as to the effect of commercial pasteurization on the antianemic potency of milk, milk pasteurized in the plant of the Department of Dairy Technology at The Ohio State University was compared with milk from the same batch after commercial pasteurization. The results obtained with this commercially pasteurized milk were the same as those obtained with the milk pasteurized under laboratory conditions.

The claim that pasteurizing destroys some of the calcifying properties of milk was not substantiated by data based on ash determinations made on the femurs of rats that had died from

anemia or had been removed from the experiment after severe anemia had developed. (Table 1).

TABLE 1.—Calcifying Properties of Raw and Pasteurized Milk (Anemia Experiments)

No. of pairs	Ash in femurs (Per cent)	
	Raw milk	Pasteurized milk
13	56.15 ± 0.47	56.01 ± 0.53*
11	58.97 ± 0.33	59.15 ± 0.37†

*Pasteurized under laboratory conditions. †Commercially pasteurized.

In order to measure the value of raw and pasteurized milk for growth, 13 pairs of rats were used. One animal of each pair received raw milk exclusively; the other received pasteurized milk exclusively. Sufficient iron and copper were added to the milk fed each rat daily to eliminate the factor of anemia. The feeding trial lasted 12 weeks. At the close of the experiment the femurs were removed from 5 pairs of rats, and the amount of ash in them was determined. The entire bodies, minus the contents of the intestinal tracts, of the remaining eight pairs were ashed. From Tables 2 and 3, it will be seen that, in this experiment, rats grew just as well on an exclusive pasteurized milk diet as on an exclusive whole milk diet, and, as in the case of rats suffering from nutritional anemia, there was no significant difference in the ash content of the femurs or of the entire bodies of rats fed either kind of milk.

TABLE 2.—Growth of Rats Fed Raw Milk or Pasteurized Milk

No. of pairs	Initial weight		Final weight		Gain in weight	
	Raw	Past.	Raw	Past.	Raw	Past.
	Gm.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
12*	49.4	49.3	165.7	162.8	116.3	113.5

*One pair eliminated because of difference in sex; included in calcification data.

TABLE 3.—Calcification in Rats Fed Raw or Pasteurized Milk (Growth Experiments)

Alimentary tract contents removed

No. of pairs	Fresh wt. of rat		Dry wt. of rat		Weight of ash		Ash (fresh basis)		Ash (dry basis)		Ash (femurs)	
	Raw	Past.	Raw	Past.	Raw	Past.	Raw	Past.	Raw	Past.	Raw	Past.
	Gm.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Gm.*	*Gm.*
8	141	132	49.96	46.80	5.93	5.54	4.23	4.22	11.97	12.10	......	......
5	......	......	......	......	......	......	......	......	......	......	62.54	62.73

It should be emphasized that the milk used in these experiments came from cows that were fed rations representative of the type of ration fed to most herds furnishing milk for city milk supplies. It would seem, therefore, from the studies thus far completed, that pasteurization of milk from cows fed an ordinary ration does not appreciably affect the nutritive value of that milk. Some destruction of vitamin C is known to occur in the pasteurizing process, but this deficiency is so easily overcome by the use of readily available sources of vitamin C, such as orange juice and tomato juice, that it is not serious.

Until further evidence to the contrary is available, no alarm need be felt over the nutritive value of present pasteurized milk supplies.

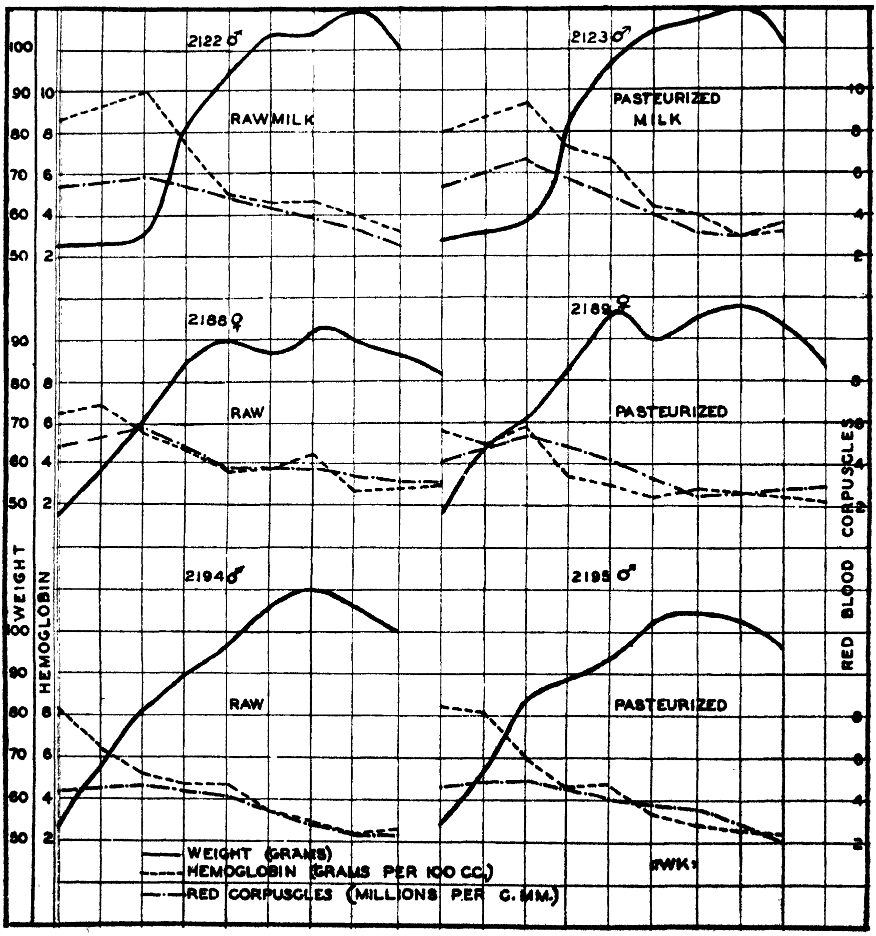

Chart 1.—Showing rate of growth and anemia development on raw and pasteurized milk. (3 typical pairs)

MOLASSES FOR FATTENING STEER CALVES

PAUL GERLAUGH

The results of the first year's work on this project are reported in Bulletin 463 from this Station. At the end of the first year's work, it was deemed unnecessary to continue the work involving the substitution of 2 pounds of cane molasses for 2 pounds of shelled corn or the self feeding of cane molasses. Two pounds of cane molasses added to the ration improved its relative position as the feeding period advanced and further work was felt necessary.

For the 1930-1931 test, all lots were fed 6½ pounds of silage daily per calf and 1½ pounds of mixed clover and timothy hay. The first four lots were fed 2 pounds of a mixture of equal parts linseed meal and cottonseed meal.

Lot 1 was full fed shelled corn.

Lot 2 was fed 2 pounds of cane molasses daily per calf and full fed shelled corn.

Lot 3 was fed 1 pound of cane molasses and full fed shelled corn.

Lot 4 was fed ½ pound of cane molasses and full fed shelled corn.

Lot 5 was fed similarly to Lot 3, excepting that 1 pound of protein supplement was replaced by 1 pound of shelled corn.

The calves used in the test were purchased through the National Order Buying Company and originated in northwestern Montana. They arrived in Wooster on October 22 and were started on test November 11. The calves were about 30 pounds heavier than the calves used the previous year. The molasses used was obtained from the same source as that used the previous year.

It is thought that the calves fed 1 or 2 pounds of molasses daily made more growth than the calves fed ½ pound of molasses or no molasses. The calves in Lot 2 were fatter than the Lot 1 calves after being on feed for 4 months. This is a shorter period of time to take the lead in fatness than was necessary in the previous test. The additional weight of the calves at the start of the test may explain this point.

The calves in Lot 3, fed 1 pound of molasses, did not equal the Lot 1 calves in condition until after being on test about 7 months. Lot 4 paralleled Lot 1 in gains, growth, and condition throughout the test.

The valuations placed on the feeds show molasses valued slightly higher per pound than shelled corn. Had it been possible to value the molasses at the same price per pound as corn, the cattle fed 1 pound of molasses would have shown less loss per steer than those fed no molasses.

We consider that 2 pounds of molasses are too much for economical results in fattening calves. More work is planned on the use of ½ pound and 1 pound of molasses in the ration.

The Lot 5 calves did not gain as satisfactorily as the other lots for the first 6 months of the test. Had the calves been sold at that time they would have been the least profitable of the various lots; however, during the last 4 months of the test this lot of calves gained exceptionally well and finished the test as one of the most desirable lots. It would seem from their performance that more protein supplement is needed in the ration of calves until the calves reach a weight around 800 pounds than afterward. More work is planned on this point.

Lots 1 and 2 were on cooperative test with the United States Department of Agriculture to learn whether differences in the quality and palatability of the meat from these steers existed. Mr. O. G. Hankins was in charge of the Department's phase of the work. These results will be available at a future date.

TABLE 1.—Molasses Feeding Test, Twenty Steer Calves per Lot

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Cost per cwt. as feeders	$10.00	$ 10.00	$ 10.00	$10.00	$10.00
Av. initial weight, Nov. 11, 1930, lb.	406.5	404.7*	403.7	404.6	407.5*
Av. final weight, Aug. 18, 1931, lb.	980.5	1028.4*	1015.2	977.6	996.4*
Av. daily gain (168 days), Nov. 11 to Apr. 28, lb.	2.27	2.35	2.30	2.28	2.20
Av. daily gain (280 days) Nov. 11 to Aug. 18, lb.	2.05	2.23	2.19	2.05	2.10
Av. daily ration, lb.:					
Shelled corn	10.74	10.82	10.75	10.43	11.62
Protein supplement†	1.99	1.99	1.99	1.99	0.99
Silage	6.47	6.5	6.5	6.5	6.49
Mixed hay	1.48	1.5	1.49	1.49	1.49
Molasses	....	1.96	0.99	0.5	0.99
Cost per cwt. gain	$10.16	$ 10.72	$ 10.20	$10.36	$10.25
Necessary selling price (home weights)	$10.09	$ 10.43	$ 10.12	$10.21	$10.14
Pork credit per steer, lb.	47.7	48.1	47.8	46.4	53.0
Necessary selling price with pork credited	$ 9.75	$ 10.11	$ 9.79	$ 9.88	$ 9.76
Market appraisal, Sept. 1 (less 75c. cwt. mkt. chg.)	$ 9.67	$ 9.75	$ 9.67	$ 9.42	$ 9.67
Loss per steer	$ 0.81	$ 3.64	$ 1.23	$ 4.49	$ 0.94
Returns per bu. corn fed	$ 0.687	$ 0.633	$ 0.676	$ 0.616	$ 0.684
Water consumption (Apr. 15 to Aug. 18, gal.)	6.895	6.942	7.429	7.340	....

*Three steers removed from Lot 2—one each on Feb. 3, Mar. 6, May 11. One from Lot 3 on Feb. 8 as of Feb. 3, and 3 from Lot 5 on Feb. 3.

†The protein supplement was equal parts linseed meal and cottonseed meal.

Feed prices: Corn 70¢ per bu.; protein $37.50, silage $5.50, hay $25.00, salt $20.00 per ton; molasses $1.50 per cwt., hogs $7.00 cwt.; calves cost $37.50 each, delivered at Wooster.

THE EFFECT OF TIME OF TAKING, MEDIUM, AND BOTTOM HEAT ON THE ROOTING OF EVERGREEN CUTTINGS

H. C. ESPER

Successful commercial propagation of various evergreens by cuttings is affected by the time of taking, the medium, and the bottom heat, and, when one or more of these factors is limiting, the results are unsatisfactory.

The practice usually has been to start taking the cuttings in early fall and to continue whenever the weather is favorable until a short time before growth starts in the spring. The medium usually has been sand, but certain merits of peat and other materials have been shown by a number of workers. The amount of heat which has been normally applied has generally been relatively low, approximating from 50-55° F. Such low bottom temperatures have recently been questioned by experimenters.

With these three prime factors in mind, a series of experiments was begun during the winter of 1929-1930 and extended through the winter of 1930-1931 to determine the conditions most nearly ideal for propagation of evergreens by cuttings. A brief outline of the experiments follows:

MEDIA

1. 100% Washed Zanesville (Ohio) Sand. A local bank sand, containing much sharp material; very few soil particles; medium coarse, and testing pH 8.2.

2. 100% German Sphagnum Peat Moss. This peat moss is a standard commercial product coming from the peat bogs of Germany. It tests around pH 4.2-4.4. It seemingly possesses antiseptic and insulating qualities. It is capable of holding large quantities of water.

3. 100% Agricultural Slag. This is a by-product of the Youngstown (Ohio) blast furnaces and has been recommended from time to time as a propagating medium. It is very porous, and large quantities of water may be applied to it without fear of overwatering. It sometimes packs too hard in the propagating bench. The slag used in this experiment was an especially processed material and was ground finely. It possessed a pH of 8.5.

4. 50% German Peat Moss plus 50% Washed Zanesville Sand. The peat moss was wet thoroughly and then evenly mixed with the

sand in a mortar box, and the mixture placed on the bench. This mixture holds water well, being easier to regulate from this standpoint than peat alone. It is also easier to firm and cuttings are more easily inserted. This mixture ran a little over the neutral point, testing pH 7.2.

5. 50% German Peat Moss plus 50% Agricultural Slag. The same process was followed here as in (4). This mixture was quite alkaline, testing pH 8.0. It was rather hard to firm, but the moisture relations were nearly ideal.

CUTTINGS

A representative of each genus of evergreen which is commonly propagated by cuttings was included, as follows, in the experiment:

1. *Thuya occidentalis*—American Arborvitae
2. *Juniperus chinensis pfitzeriana*—Pfitzer's Juniper
3. *Juniperus sabina*—Savin Juniper
4. *Taxus cuspidata*—Japanese Yew
5. *Chamaecyparis pisifera plumosa*—Plumy Retinospera

Considerable experimental error was introduced during the second year because the cuttings were obtained from various sections of the State and differed considerably in moisture content, due to the extreme drouth in some sections of the State.

TIME OF TAKING CUTTINGS

During the season 1929-1930, cuttings were taken in three lots, the first on November 1, the second on December 26, and the third on February 12. During the season 1930-1931, sets of cuttings were taken November 20, January 5, January 24, February 19, and March 25. All cuttings were taken during clement weather and, if frozen, were thoroughly thawed out in a cool place before placing them in the propagating house.

BOTTOM HEAT

Two benches were used for this test, identical in every respect except that one received additional heat at the bottom, the temperature beneath the bench averaging from 65°-68° F., while the other bench received no additional bottom heat, and the bottom temperature averaged from 50°-51° F., a difference of from 15°-17°.

DISCUSSION OF RESULTS

TIME OF TAKING

Although a greater percentage of cuttings of *Chamaecyparis* rooted when taken in November in the first year's results, greater root length was obtained on cuttings taken in December. Second year's results were too poor for comparison (Tables 1 and 6).

TABLE 1.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Chamaecyparis pisifera plumosa, 1929-1930

Medium	November 1-29				December 26-29				February 12-30			
	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.
					Bottom heat							
Sand	45	90	228.0	5.06	35	70	302.4	8.64	23	48	82.8	3.6
Peat and sand	45	90	262.7	5.83	34	68	457.3	13.44	3	6	24.9	8.3
Peat.........	48	96	307.7	6.40	33	66	459.6	13.93	1	2	7.5	7.5
Slag.........	24	48	59.3	2.47	30	60	217.2	7.24	17	34	56.1	3.3
Peat and slag	34	68	145.2	4.27	44	88	393.8	8.95	8	16	20.1	2.51
					No bottom heat							
Sand	17	34	105.5	6.2	19	38	146.6	7.72	23	46	97.4	4.23
Peat and sand	12	24	132.1	10.0	33	66	213.7	6.5	20	40	129.0	6.45
Peat.........	9	18	49.4	10.44	19	38	153.8	8.1	32	64	299.6	9.36
Slag.........	28	56	126.3	4.51	34	68	105.7	3.11	39	78	117.8	3.02
Peat and slag	36	72	214.4	6.93	40	80	280.8	7.02	29	58	115.2	3.97

Thuya occidentalis cuttings responded with highest percentage rooting in November in both first- and second-year experiments. Not much difference in root length was observed for the various periods. (Tables 2 and 7).

In both years' experiments with *Taxus cuspidata,* cuttings taken in December and early January produced more rooted cuttings than in any other period. Greatest length of roots was observed on December cuttings. (Tables 3 and 8).

First year's results with *Juniperus chinensis pfitzeriana* showed more cuttings rooting when taken in November than when taken at any other period. Length of roots was approximately the same for all periods. Due to drouth conditions which prevailed the summer of 1930, the cuttings of this evergreen did not root sufficiently to consider the results (Tables 4 and 9).

TABLE 2.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Thuya occidentalis, 1929-1930

Medium	November 1-29				December 26-29				February 12-30			
	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.
					Bottom heat							
Sand	33	66	336.8	10.2	39	78	399.1	10.23	4	8	5.2	1.3
Peat and sand	40	80	330.9	8.3	42	84	455.2	10.84	14	28	167.0	12.0
Peat	35	70	352.2	12.9	38	78	539.5	14.19	10	20	96.5	9.65
Slag	28	56	124.1	4.43	46	92	352.4	7.66	25	50	154.8	6.19
Peat and slag	26	52	99.5	3.63	44	88	494.4	11.23	20	40	97.2	4.86
					No bottom heat							
Sand	27	54	278.2	10.3	15	30	96.8	6.45	19	38	117.1	6.21
Peat and sand	32	64	383.2	12.0	34	68	331.9	9.76	37	74	369.4	9.98
Peat	19	38	272.0	14.31	34	68	539.8	15.87	21	42	263.9	12.56
Slag	31	62	208.7	6.66	44	85	313.8	7.13	37	74	199.5	5.40
Peat and slag	24	48	214.3	8.94	41	82	364.7	8.89	41	82	241.6	5.89

TABLE 3.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Taxus cuspidata, 1929-1930

Medium	November 1-29				December 26-29				February 12-30			
	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.
					Bottom heat							
Sand	12	24	38.1	3.17	31	62	188.1	6.07	32	64	97.4	3.04
Peat and sand	27	54	88.5	3.27	25	50	170.0	6.80	19	38	32.4	1.70
Peat	14	28	8.06	8.48	35	70	372.6	10.64	20	40	163.8	8.19
Slag	42	84	130.6	3.11	43	86	273.5	6.36	20	40	58.0	2.90
Peat and slag	37	74	151.0	4.08	36	70	236.3	6.56	17	34	74.5	4.38
					No bottom heat							
Sand	17	34	63.8	3.75	31	62	91.3	2.94	3	6	1.3	0.43
Peat and sand	26	52	180.6	6.94	17	34	86.7	5.10	5	10	26.7	5.34
Peat	6	12	28.2	4.70	4	8	25.7	6.42	15	20	81.0	5.40
Slag	21	42	64.6	3.07	......	......	......	......	......	......	......	......
Peat and slag	19	38	109.3	5.22	25	50	149.2	5.96	7	14	13.4	1.91

More cuttings of *Juniperus sabina* rooted when taken in November than at any other date, both years' results being similar in this case. Root length was greatest on cuttings taken in December.

TYPE OF MEDIUM

When cuttings of *Chamaecyparis* (Tables 1 and 6) were propagated in November, pure peat moss was the most satisfactory medium. December propagation of this evergreen gave most satisfactory results in a mixture of peat and slag; whereas those propagated in February were best in pure slag. However, where no bottom heat was applied, pure slag and the mixture of peat and slag gave best results irrespective of the time the cuttings were taken.

TABLE 4.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Juniperus chinensis pfitzeriana, 1929-1930

Medium	November 1-29				December 26-29				February 12-30			
	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.
Bottom heat												
Sand	24	48	136.5	5.70	23	46	153.6	6.68	1	2	0.5	0.5
Peat and sand	36	72	244.7	6.79	4	8	20.3	5.07	4	8	17.4	4.35
Peat	30	60	147.0	4.90	34	68	393.3	8.62	2	4	21.7	10.85
Slag	36	72	226.5	6.29	19	38	103.9	5.47	2	4	13.6	6.80
Peat and slag	32	64	244.88	7.65	19	38	102.0	5.36	0	0	0.0	0.0
No bottom heat												
Sand	23	46	185.4	8.06	7	14	48.7	6.95	2	4	4.6	2.3
Peat and sand	19	38	180.3	8.48	38	76	290.2	7.63	1	2	6.0	6.0
Peat	27	54	386.9	14.33	6	12	39.7	6.61	2	4	9.0	4.5
Slag	32	64	225.0	7.06	29	58	84.8	2.92	2	4	2.0	1.0
Peat and slag	20	40	142.9	7.14	16	32	18.34	1.15	0	0	0.0	0.0

The November, December, and early January sets of cuttings of *Thuya occidentalis* (Tables 2 and 7) gave a greater percentage of rooted cuttings in the mixture of peat and sand; whereas the February sets were most satisfactory in slag in the first year and in sand in the second year. In the unheated plots, pure slag and the mixture of peat and slag were best.

In the first year experiments, pure slag showed superior rooting for the lots of cuttings of *Taxus cuspidata* (Tables 3 and 8)

NOTE: (In the discussion below, the total number of cuttings rooting or the percentage rooting is the basis for all conclusions).

taken in November and December, but pure sand was most satisfactory in February. The second year's results showed the mixture of sand and peat to be most satisfactory for November and February and pure sand for December. Where no bottom heat was applied, the mixture of peat and sand gave highest rooting in November in the first year's results, sand in the December lot, and pure peat in February. The second year's results without bottom heat uniformly favored pure sand.

Cuttings of *Juniperus chinensis pfitzeriana* (Tables 4 and 9) were best in November in pure slag and the mixture of peat and slag, and the cuttings made in December showed most rooting in pure peat and the mixture of peat and sand. Second year results were too poor to compare with those of the first year.

TABLE 5.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Juniperus sabina, 1929-1930

Medium	November 1-29				December 28-29				February 12-30			
	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.	No. rooted	Pct. rooted	Total root length cm.	Av. root length cm.
Bottom heat												
Sand	19	38	91.6	4.82	13	26	108.4	8.34	0	0	0	0
Peat and sand	18	36	67.1	3.73	30	60	287.0	9.56	0	0	0	0
Peat	16	32	52.5	3.26	23	46	227.1	9.44	0	0	0	0
Slag	23	46	127.6	5.39	28	56	176.1	6.29	6	12	18.3	3.05
Peat and slag	24	48	82.6	3.44	28	56	296.5	5.18	0	0	0	0
No bottom heat												
Sand	15	30	127.2	8.48	39	78	86.4	2.21	0	0	0	0
Peat and sand	29	58	294.7	10.16	20	40	193.3	9.86	1	2	0.7	0.79
Peat	24	48	195.7	8.15	23	46	171.5	7.46	0	0	0	0
Slag	42	84	208.3	4.96	32	64	151.0	4.72	7	14	35.6	5.08
Peat and slag	19	38	127.4	6.70	30	60	157.78	5.23	0	0	0	0

Slag and the mixture of peat and slag proved to be almost uniformly the best rooting media for *Juniperus sabina* (Tables 5 and 10). Exceptions were the mixture of peat and sand in the December plots and pure sand in the same set of cuttings, where no bottom heat was applied. The second year's results favored sand in the unheated sections.

The experimental evidence dealing with media does not warrant the selection of one general medium which would do satisfactorily for all types of cuttings taken at all times of the year.

However, if one were to be chosen which showed satisfactory results for all cuttings, it would be the mixture of peat and slag. Pure peat moss, although showing favorable results in a number of cases, probably never will be used commercially alone as a rooting medium, due to the fact that it is difficult to maintain uniformity of moisture. The mixture of peat and sand has possibilities; pure sand is not universally the best rooting medium.

TABLE 6.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Chamaecyparis pisifera plumosa, 1930-1931

Temperature	November 20		January 5		January 24		February 19		March 25	
	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living
Sand										
Bottom heat.......	8	24	0	0	0	16	8	16	0	0
No bottom heat ...	18	24	0	0	48	80	68	84	11	44
Peat										
Bottom heat.......	8	8	0	0	4	28	12	12	0	0
No bottom heat ...	12	12	0	0	0	8	24	36	0	0
Peat and sand										
Bottom heat.......	8	8	4	8	4	36	56	72	0	0
No bottom heat ...	20	24	0	0	0	32	56	80	0	0

TABLE 7.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Thuya occidentalis, 1930-1931

Temperature	November 20		January 5		January 24		February 19		March 25	
	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living
Sand										
Bottom heat.......	16	56	68	68	8	68	12	68	0	20
No bottom heat ...	8	88	96	100	12	88	60	100	16	84
Peat										
Bottom heat.......	36	64	16	32	16	52	24	76	0	20
No bottom heat ...	0	68	92	92	0	28	0	64	0	18
Peat and sand										
Bottom heat.......	36	36	84	92	8	68	44	48	18	56
No bottom heat ...	24	64	96	80	0	68	32	96	0	56

BOTTOM HEAT

In the majority of cases bottom heat increased the percentage of cuttings rooted. However, several exceptions to this generalization must be pointed out: (1) In practically every case, with the possible exception of *Taxus cuspidata,* the sets of cuttings taken in February or later rooted much more satisfactorily in the plots which did not receive bottom heat. Replications were sufficient to warrant this conclusion.

TABLE 8.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Taxus cuspidata, 1930-1931

Temperature	November 20		January 5		January 24		February 19		March 25	
	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living
					Sand					
Bottom heat.......	12	40	65	76	....	....	20	92	....	....
No bottom heat ...	8	76	48	52	....	....	12	100	....	....
					Peat					
Bottom heat.......	16	46	60	72	....	....	4	64	....	....
No bottom heat ...	0	32	8	36	....	....	0	64	....	....
					Sand and peat					
Bottom heat.......	44	56	36	48	....	....	24	52	....	....
No bottom heat ...	0	56	12	72	....	....	12	76	....	....

TABLE 9.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Juniperus chinensis pfitzeriana, 1930-1931

Temperature	November 20		January 5		January 24		February 19		March 25	
	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living
					Sand					
Bottom heat.......	0	52	4	84	4	32	0	48	0	56
No bottom heat ...	0	64	0	4	0	100	4	100	0	100
					Peat					
Bottom heat.......	8	44	40	66	0	32	0	20	0	12
No bottom heat ...	0	2	4	80	0	0	0	0	0	12
					Peat and sand					
Bottom heat.......	0	64	20	96	8	56	0	76	0	60
No bottom heat ...	0	46	4	80	4	80	4	88	0	96

(2) *Juniperus sabina* cuttings rooted better where no bottom heat was applied.

(3) Slag seemed to be the most satisfactory medium in the unheated plots.

TABLE 10.—Effect of Time of Taking, Type of Medium, and Bottom Heat on Rooting

Juniperus sabina, 1930-1931

Temperature	November 20		January 5		January 24		February 19		March 25	
	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living	Pct. rooted	Pct. living
Sand										
Bottom heat.......	40	100	32	84	36	96	8	96	0	60
No bottom heat ...	40	100	76	100	68	96	84	100	32	96
Peat										
Bottom heat.......	44	94	8	72	52	68	40	80	0	8
No bottom heat ...	0	76	0	56	0	52	16	100	0	12
Peat and sand										
Bottom heat.......	72	100	32	68	48	100	48	84	16	80
No bottom heat ...	26	96	36	76	60	80	72	96	8	88

CONCLUSIONS

1. A greater percentage of rooted evergreen cuttings is obtained if the cuttings are taken in late fall or early winter.

2. A mixture of peat and slag, 50% of each, generally rooted a greater percentage of evergreen cuttings than pure sand.

3. Not all evergreen cuttings respond similarly to the same medium.

4. The type of medium which seems most satisfactory for November propagation will not always suffice for December, January, or February propagation.

5. A bottom heat of from 65-70° F., with an overhead temperature of from 50-55° F., is the most desirable for propagation of evergreen cuttings.

6. *Juniperus sabina* rooted better with low bottom heat.

THE NEW "OHIO CANNER" TABLE BEET

ROY MAGRUDER[1]

The grade, and consequently the selling price, of canned beets depends largely upon the color of the product. A solid, medium or dark red color is preferred. When a lot of beets containing a large percentage of roots with broad white zones or growth rings is canned, the product is pale or light red in color and the loss to the canner because of the low grade is sometimes rather large. Since it is impossible to determine accurately the color of the interior of the root from external appearance, it is impossible to eliminate the poorly colored roots before they are canned. The importance of securing varieties or strains free from poorly colored roots is therefore evident.

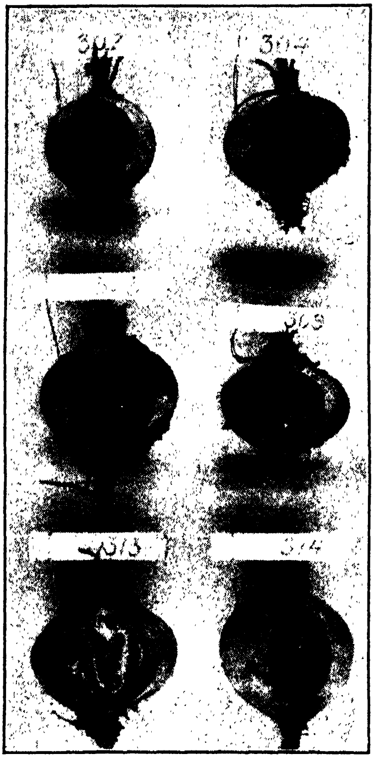

Fig. 1.—Showing shape and relative width of zone of mother beets and illustrating the method of removing a sector of tissue to show interior flesh color.

The commercial strains of beets in 1923 were so poor in color that the Ohio Canners' Association requested the Ohio Agricultural Experiment Station to start breeding work on the production of an early maturing, round, solid dark red fleshed beet. They felt that the presence of poorly colored roots was an indication of poorly bred seed stock.

Work was immediately begun on the problem, and, as a result, a new variety of table beet, the Ohio Canner, will soon be available to the public.

METHOD OF IMPROVEMENT

Careful notes and records were taken on 30 samples in the 1923 variety and strain trials. From this number, all of the roots of the two best varieties were stored over winter in a basement storage in

[1]Formerly of the Department of Horticulture, Ohio Experiment Station; now of the U. S. D. A.

bushel crates of fairly dry soil. The two varieties chosen were Deep Blood Turnip from the Holmes Seed Company and the Chicago Market from Vaughn's Seed Company.

Early in May all of the roots were removed from storage and examined for flesh color. In order to examine the internal color, a sector of the flesh was cut from the side of the beet as shown in Figure 1. This method made it possible to determine quickly the relative width and color of the growth rings or zones. Only the best roots were saved for seed production; i. e., those of round or nearly round shape in which the darker zone was very dark red with narrow lighter colored zones.

Since self-sterility was known to exist in sugar beets, it was assumed that this might prevent the production of selfed seed in the table beet, and hence part of the selected roots were planted in pairs; i. e., two beets in each of several widely separated gardens in the city of Wooster. A few single roots were also grown in isolated locations. Many of the isolated plants failed to produce any viable seed, and in all cases the production was very small. Production of seed in the paired roots was good in most cases. One pair produced almost one-fourth of a pound of cleaned seed.

TESTING PROGENY OF PAIRS OF MOTHER BEETS

The seed produced from the mother beets in 1924 was sown in the spring of 1925, the seed from each pair or from a single root being planted in a separate row. In the fall, each lot was harvested and stored separately. When the color record was made the following spring, it was found that lots whose parents had the same description differed quite widely in shape and color, Figure 2. These hybrid lots were, however, in general more uniform in shape and color than commercial varieties.

Selections of pairs of roots of the same type were again made from the best two progeny lines or rows. All of the roots from the poorest rows were discarded.

Twenty-nine pairs of roots and nine singles were planted in 1926. Some pairs were started early in separated greenhouses, some were planted in widely separated gardens, and others were grown under cheesecloth cages in the Station gardens.

The seed from each single or pair of beets was planted in a separate row in the spring of 1927. Records were made during the season on the uniformity of foliage, and at harvest time in late fall only the rows with the most uniform and desirably shaped roots were saved for storage. The next spring (1928), the flesh color of each root was examined, and all lots except the best three were discarded.

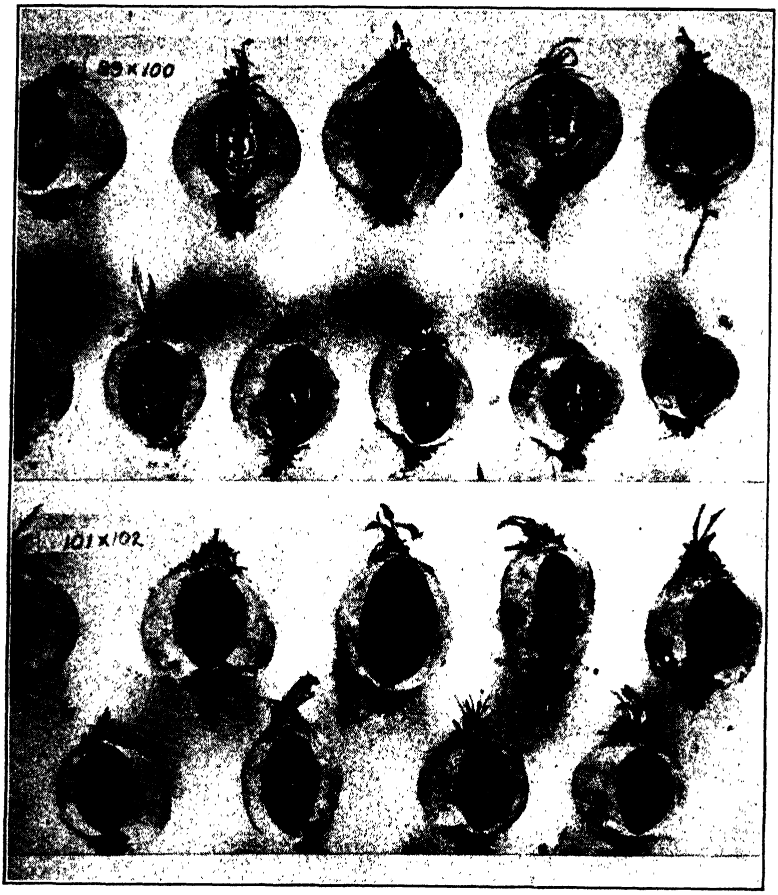

Fig. 2.—Random sample from the progeny of two pairs of seed beets of the same type, showing the difference in shape and amount of white zoning

The best three lots were more uniformly and desirably colored than commercial lots of the Detroit Dark Red variety commonly used for canning, and, after the required number of pairs of beets was selected, the remainder of the desirable roots were planted in isolated fields on the Station farm to produce a quantity of seed for testing the canning qualities of these strains.

1929 TESTS OF INCREASE SEED

Small lots of this increase seed were sent in the spring of 1929 to beet canners in eight states, to several colleges and Experiment Stations, and to a few seedsmen who asked for samples. Most of them made some kind of a report, and, in a few instances, the

canners actually canned roots and sent the writer canned samples from the Station seed and from their commercial seed. All three lots were very similar in flesh color but differed in uniformity, shape, and size of top. After all the records were studied, one strain was selected for commercial increase. The following notes on color refer only to this one strain, which has since been named "Ohio Canner".

1929 REPORTS FROM CANNERS

Seven reports of a more or less complete nature were received from canners in Ohio, Indiana, New York, Utah, Oregon, and California, who grew this variety in comparison with their commercial stock of seed. All of them agreed that the color was darker red than the Detroit Dark Red they were using, and two mentioned that there were less white rings or zones in the Ohio Canner. It was also noted that the Ohio Canner produced a larger percentage of the smaller sized roots, indicating that it grew more slowly than the commercial strain. The tops were shorter, and more of the large roots were flatter than in Detroit Dark Red. Two canners found an objectionable percentage of carrot-shaped roots when the roots were an inch or less in diameter.

TABLE 1.—Percentage of Each Internal Color Class in 1929 Beet Trial at Pennsylvania State College

Variety	Seedsman	Color of zones or growth rings							
		Red flesh				Purple flesh			Broad white zones
		Very dark	Dark	Light	White	Dark	Light	White	
Ohio Canner...	O. A. E. S......	62	22	13	....	3	....	....	....
2505............	Vilmorin.......	6	11	2	....	8	72	....	2
Detroit.........	Stokes..........	....	56	35	....	....	2	7	....
Black Ball.....	Burpee..........	2	9	18	....	9	44	18	....

Canned samples of Ohio Canner and commercial Detroit Dark Red beets from two Ohio canners and one New York canner were opened and graded by a group of canners who did not know their identity, at a Canners' Conference held at the Ohio State University. In every case, the Ohio Canner was given the higher rating for color and no objection was made as to flavor.

REPORTS FROM COLLEGES AND EXPERIMENT STATIONS

Table 1 gives the Pennsylvania State College report of the classification of the color of the interior of the roots.

"Broad white" zoned roots are those in which the white zone is equal to or greater than the adjacent colored zones in width.

"Light" zones are colored but lighter than the adjacent colored zones, and "very dark" zoned roots are those in which the zoning is indistinct because of the uniform, very dark red color of the flesh.

TABLE 2.—Percentage of Each Shape in 1929 Beet Trial at Cornell University

Variety	Seedsman	Root shape						
		Flat	Oblate	Deep oblate*	Round	Oval	Short top	Long top
Ohio Canner	O. A. E. S.	....	....	55	32	3	10	....
Detroit	Assoc. S. Gr.	2	23	....	33	10	32	....
Detroit	Z. & DeW.	2	24	....	20	13	33	7
Detroit	Harris	7	16	5	36	5	29	....

*Deep oblate roots are those that are too flat on the top and bottom to be classed as round.

The report from Cornell University gives data on shape, as well as interior flesh color, Table 2.

Table 3 gives the data on flesh color of a few of the strains with which Ohio Canner compares in season of maturity.

TABLE 3.—Percentage of Each Internal Color Class in 1929 Beet Trial at Cornell University

Variety	Seedsman	Color of zones or growth rings			
		Dark	Light	White	Broad white
Ohio Canner	O. A. E. S.	99	1	....	....
Detroit 917.3	Assoc. S. Gr.	65	35	....	....
Detroit	Z. & DeW.	33	43	22	2
Detroit 226	Harris	31	65	4	....
Detroit 34068	Ferry	62	38	....	....
Detroit Imp. 7011	Morse	86	14	....	....

Data of a more general but corroborative nature are also available from several other colleges and Experiment Stations.

CHARACTERISTICS OF THE OHIO CANNER VARIETY

At the present time, the variety has the following characteristics: The foliage is somewhat variable in height but, in general, is 3 to 4 inches shorter than most strains of Detroit Dark Red. This shortness is due mainly to short petioles. Individual plants vary in the length of the petioles, as shown in Figure 3. The blade is very little smaller than that of ordinary strains and is borne on erect petioles giving a dense top effect to the growing plant. Rapidly growing plants have blades of medium green color with Bordeaux[2] red veins. As the leaves mature, more red stippling appears on the blade surface, and by late fall the older leaves have

[2]Capitalized color names are those of Robert Ridgway, *Color Standards and Color Nomenclature.* Published by Author, from Press of A. Hoen & Co., Baltimore, Md. 1912.

a reddish-green color. The color of the channel or inner concave side of the petiole of mature leaves is between Nopal Red and Brazil Red. The convex or outer side of the petiole has more violet in the color, which corresponds closely to Bordeaux.

Fig. 3.—Illustrating short, erect leaves of Ohio Canner (left) in comparison with commercial Detroit (right). Middle row is a slightly taller, more spreading type found in Ohio Canner. Note shape of roots.

In root shape, this variety is also somewhat variable, containing flattened oblate, deep oblate, round, and top shapes. In general, it is flatter than Detroit and more nearly like the Early Wonder variety in shape. The ideal variety for shape is one that will be round when the roots are about an inch in diameter, with a fine or small tap root. See Figure 4. The tap roots of the present strain are too large and coarse to be desirable.

Above ground, the skin of the beet root is russeted and on rapidly growing roots is lighter red than the skin underground. The color has a decided orange hue and ranges between Nopal Red and Garnet Brown. The color of the recently washed skin near the tap root corresponds closely with Hay's Maroon. The development of the phellem, or corky, outer layer of the skin on mature roots somewhat obscures the under color but the general effect is near Violet Carmine.

When freshly cut, the color of the darker zones of the flesh is between Carmine and Oxblood Red in hue. Upon exposure to the

air, the color darkens and, in a few minutes, agrees more nearly with a hue between Oxblood Red and Victoria Lake. When the section is so cut that the lighter zone color shows through the darker zone, the impression is that of Burnt Lake. A section through the lighter zone is more nearly Carmine than Oxblood Red. The skin and interior color of the Ohio Canner are more uniform than shape and foliage characters, although there are still a few roots that have a violet or purple hue. There is also some range in shade of the red color but much less than in most commercial strains.

Fig. 4.—Plants of Ohio Canner beet. Upper row shows predominant shape in different sizes of roots. Lower row shows range in shape from flattened oblate on left to round on right. Note variation in length of petioles.

This strain grows more slowly than commercial strains of Detroit Dark Red and for that reason will require a longer time to produce an equal tonnage per acre.

FUTURE IMPROVEMENTS

Most of the shortcomings of this variety have been pointed out above and future work following the methods outlined will be directed toward overcoming these defects as far, and as speedily, as

possible. More attention will be paid to isolating strains that produce round, small roots with small or fine tap roots. Rapidity of growth or earliness will also be given more weight in further breeding work, with consideration also to the retention and intensification of the dark red flesh color and the elimination of light or white zones.

MULTIPLICATION AND DISTRIBUTION OF SEED

The Experiment Station does not consider the multiplication and distribution of seed one of its functions and does not have the facilities or equipment to carry on this work. Recourse must, therefore, be had to commercial agencies. Previous experience in the promiscuous and free distribution of improved varieties to the general public has shown that in a few years the variety, in many cases, had been lost or became so mixed or degenerated as to be worthless.

In order to preserve and improve the quality of the present variety, it was thought advisable to continue the breeding work and production of stock seed at the Experiment Station and to release such seed for multiplication purposes to one commercial seed producer and distributor.

Such an arrangement has been completed with J. M. Lupton & Co. Inc., and, with favorable crop production conditions, the first commercial crop of the Ohio Canner variety will be available for distribution in the fall of 1932.

THE EXPERIMENT STATION HAS NO SEED FOR DISTRIBUTION

MARKETING CANNERY TOMATOES IN OHIO

CHAS. W. HAUCK

The canning of tomatoes and tomato products is an important industry in Ohio. In the 5 years 1926 to 1930, inclusive, the State's annual output averaged 203,000 cases of 24 No. 3 cans each. During these same years, the area planted to tomatoes for manufacture averaged 10,350 acres annually, and the production averaged 52,660 tons, with an average farm value of $640,000.

United States grades for cannery tomatoes were used on a commercial scale by Ohio canners for the first time in 1930. In that year, five tomato canners in this State, operating seven factories, purchased raw stock from growers on the basis of these standards. Approximately 9000 tons of tomatoes were received at these seven factories that season. Grades were determined by government inspection, and returns to growers were based on the proportionate amounts of each grade in the samples examined by the inspectors. Results were gratifying to canners and growers, many of whom enthusiastically endorsed the purchase of tomatoes on a graded basis, and the practice was continued by these canning companies in 1931. Other companies also adopted federal grades and government inspection as the basis for their contracts with producers in 1931, so that in that year 13 companies in Ohio, operating 15 factories, purchased their entire supplies of tomatoes on this plan.

Prior to the adoption of federal grades and inspection, it was customary for canners to buy their raw stock requirements from growers at a flat price per ton, these agreements being entered into in advance of planting. Almost without exception, contracts specified delivery of sound, red-ripe tomatoes, without provision for acceptance of poorer tomatoes under any circumstances. The canner usually reserved the privilege of rejecting deliveries that failed to meet these specifications or of "docking" returns to the grower in proportion to the amount of unacceptable tomatoes delivered, although these terms rarely appeared in the contract. The canner was the final judge of the acceptability of the tomatoes delivered.

In actual practice canners often accepted tomatoes that failed to meet contract specifications. Interpretation of the terms "sound and red-ripe" was not always constant. When the crop was large, it was natural for the buyer to become more critical of the quality

and maturity of the tomatoes; whereas, when the yield was small and the canner found difficulty in securing enough tomatoes to meet his requirements, he might overlook inferior deliveries. Acceptance of poor tomatoes at one time and insistence on high quality at another tended to destroy confidence, and business relationships suffered. Payment of all growers at the same rate per ton, regardless of quality, likewise tended to discourage the better growers and resulted in indifferent harvesting and handling. The growers' principal objective became large tonnage, without regard to quality or maturity beyond the minimum of acceptability to the buyer.

Canners constantly faced a difficult task in attempting to maintain quality. Poor tomatoes in the yard meant either poor tomatoes in the can or excessive wastage and unreasonably high packing costs. Usually it meant both. Consequently, manufacturers looked with favor upon any proposal that gave promise of improving the quality of their raw material. Many manufacturers, moreover, recognized an unfairness to the better growers in the flat-rate system of buying and were ready to adopt grading and inspection as soon as the practicability of the plan was demonstrated. Successful use of this system in other states, therefore, was soon followed by its adoption by leading canners in Ohio. The practice seems destined to grow.

TABLE 1.—Value of Cannery Tomatoes per Ton to Ten Ohio Growers, 1930

Grower	U. S. No. 1			U. S. No. 2			Culls		Price per ton to grower
	Per cent	Pounds per ton	Value at $18 per ton	Per cent	Pounds per ton	Value at $10 per ton	Per cent	Pounds per ton	
			Dol.			Dol.			Dol.
A........	94	1880	16.92	6	120	0.60	......	....	17.52
B........	90	1800	16.20	10	200	1.00	......	....	17.20
C........	86	1720	15.48	14	280	1.40	......	....	16.88
D........	56	1120	10.08	41	820	4.10	3	60	14.18
E........	45	900	8.10	55	1100	5.50	......	....	13.60
F........	51	1020	9.18	44	880	4.40	5	100	13.58
G........	39	780	7.02	61	1220	6.10	......	....	13.12
H........	30	600	5.40	64	1280	6.40	6	120	11.80
I........	23	460	4.14	37	740	3.70	40	800	7.84
J........	7	140	1.26	52	1040	5.20	41	820	6.46

Growers received $114,538.61 for tomatoes delivered to these seven factories in 1930, an average of $12.59 per ton. Most Ohio tomato canners in that year paid flat rates of $10 to $12 per ton. Prices paid by canners employing U. S. grades and government inspection varied from $13 to $18 per ton for U. S. No. 1's and from $9 to $12 per ton for U. S. No. 2's. No payment was made for culls.

Returns to growers fluctuated in direct relationship with the quality of the tomatoes delivered. Growers who delivered stock containing large percentages of U. S. No. 1 grade and small percentages of U. S. No. 2 grade and culls received a premium; whereas growers who delivered tomatoes running heavily to the lower grades were discounted proportionately. To illustrate, ten loads of tomatoes delivered by as many growers to one plant in 1930 were selected for comparison. The value per ton was computed at the rates of $18 per ton for U. S. No. 1's and $10 per ton for U. S. No. 2's. The percentages of each grade in each load were taken directly from the inspection certificates, and the computations were made on a ton basis to simplify the comparisons.

It will be noted that these ten individuals received prices ranging from $6.46 per ton to $17.52 per ton, depending entirely upon quality. Contract prices in all cases were identical. The extreme range in values between Grower A and Grower J is significant.

FARM HOUSING IN OHIO

C. E. LIVELY

During the last 10 years a number of studies of rural conditions have thrown some light upon the farm housing situation in Ohio. During the years 1923-1925 several brief housing surveys were made by advanced students under the direction of C. E. Lively. These surveys included 455 farm families in six contiguous sample areas in Champaign, Geauga, Portage, and Richland Counties. The results indicated that 91 per cent of the dwellings were of frame construction, 7 per cent of brick, and 2 per cent of log or other construction. As to repair, 4 per cent were said to be new, 52 per cent in good repair, 36 per cent fair, and 8 per cent in a poor or dilapidated condition. With respect to size, 2 per cent possessed less than five rooms, 37 per cent possessed from 5 to 7 rooms, 49 per cent had 8 to 10 rooms, and 12 per cent had more than 10 rooms. The average size was slightly more than eight rooms. The number of rooms per person showed wide variation. In 9 per cent of the dwellings there was less than one room per person. In 36 per cent of the cases there were 1-2 rooms per person, in 30 per cent of the cases 2-3 rooms per person, in 11 per cent of the cases 3-4 rooms per person, and in 14 per cent of the cases 4 or more rooms per person.

The distribution of major conveniences in Ohio farm homes may be indicated by the fact that 24 per cent of the dwellings had furnace heat, 24 per cent had gas or electric lights, 6 per cent had running water, and 5 per cent had indoor toilets.

A survey of 610 farm homes in Madison and Union Counties, Ohio, in 1928 showed that the average house possessed 6.9 rooms, that 85 per cent were screened, 31 per cent had gas or electric lights, 21 per cent had furnaces, and 25 per cent had running water in the house. This survey was made by E. D. Tetreau.

A survey of 383 farm families in Delaware County, Ohio, made by Kirkpatrick and Melvin in 1924 showed that the total number of rooms used per family was 7.2, with 3.4 bed rooms per family. Nine per cent were classed as completely modern houses, and 5 per cent as partially modern. Ninety-four per cent of tenant houses were not modern.

The above data may be regarded as fairly typical of western and northern Ohio, which includes the best agricultural, as well as the most highly urbanized, sections of the State.

In southeastern Ohio, which comprises about one-third of the area of the State, the topography is hilly and agriculture is less prosperous. Here the housing conditions may be inferred from the results of certain recent studies. A study of land utilization in Vinton County, conducted in 1930 by Sitterley, Moore, and Falconer, revealed that, of the 2012 inhabitable houses, 14 per cent were of brick or painted frame construction with good roof and foundation. These were classified as "good". Twenty-nine per cent were not necessarily painted but possessed good roofs and foundations and would last a number of years. These were classified as "fair". The "poor" houses were badly in need of repair and paint and had poor foundations. Some were log cabins. They comprised 34 per cent of the total. The remaining 23 per cent were classified as "dilapidated". They were on the verge of being uninhabitable. Many were log cabins.

By similar criteria, a total of 4780 houses in Lawrence County was classified in 1931 as 19 per cent "good", 34 per cent "fair", 32 per cent "poor", and 15 per cent "dilapidated".

These conditions may be regarded as representative of the poorer hill counties in Ohio.

OHIO FARMS GROW LARGER

J. I. FALCONER

In the Bimonthly Bulletin of July-August, 1931, a chart was given showing, by counties in Ohio, the change in average size of farms from 1920 to 1930. The present article gives further detail for the State as a whole. The average size of Ohio farms in 1910 was 88.6 acres, in 1920 it was 91.6 acres, and in 1930 it was 98.1 acres. The accompanying table shows that in 1920 30 per cent of the farms was less than 50 acres in size, 33.6 per cent was from 50 to 99 acres in size, and 36.4 per cent was over 100 acres in size. In 1930, the percentages were 26.7, 32.4, and 40.7 per cent, respectively. Thus, it appears that farms of less than 50 acres are decreasing in relative numbers, farms of 50 to 99 acres are holding their own, and farms of over 100 acres are increasing in the percentage of all farms.

TABLE 1.—Farms by Size Groups—Ohio

Acres	Number			Per cent of total		
	1910	1920	1930	1910	1920	1930
Under 10	20,197	15,867	12,550	7.4	6.2	5.7
10- 19	18,716	15,612	12,359	7.0	6.1	5.6
20- 49	50,331	44,535	33,734	18.5	17.7	15.4
50- 99	88,047	86,337	71,160	32.3	33.6	32.4
100-174	68,746	69,738	63,920	25.3	27.1	29.1
175-259	18,211	17,371	17,790	6.4	6.8	8.1
260-499	6,902	6,402	6,888	2.4	2.5	3.1
500-999	783	728	791	0.3	0.3	0.4
1000 and over	112	105	104	....	....	....
Total	272,045	256,695	219,296	....	....	....

It is also of interest to note that the three size groups from 175 to 1000 acres were the only groups which showed an actual increase in the number of farms. The greatest percentage increase in numbers came in farms from 500 to 999 acres. In Paulding County, 37 per cent of the farms in 1910 was 100 acres or over in size; in 1930, 57 per cent was 100 acres or over. In Madison County, which has the largest average size of farm of any Ohio county, the average size of farm increased from 163 acres in 1920 to 177 acres in 1930. Only 11 counties of the total of 88 in the State showed a decrease in average size of farms from 1920 to 1930, and these counties were mostly in the northeastern quarter of the State. There is evidently a very distinct tendency for Ohio farms to become larger in size.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

In April the drouth of the past year was broken, and since that time weather conditions have been favorable. Wheat yields surpassed those of any preceding year by nearly 5 bushels per acre; the 1931 Ohio corn crop has been exceeded only five times in the past 20 years. As far as production is concerned, the year 1931 was very satisfactory to Ohio farmers. Low prices, however, have reduced the income below that of last year. It is estimated that for the first 10 months of the year the income from the sales of farm products was 29 per cent below that of 1930. The prices of Ohio farm products in October of 1931 were down to the level of the year 1900 but 30 per cent above that of 1896.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	199	100	101	102	102	102	105	107
1915........	102	101	106	100	103	107	106	110
1916........	125	114	123	117	113	113	121	121
1917........	172	129	150	176	140	119	182	198
1918........	192	160	178	200	175	131	203	243
1919........	202	185	205	209	204	135	218	266
1920........	225	222	206	205	236	159	212	242
1921........	142	203	156	116	164	134	132	136
1922........	141	197	152	125	145	124	127	136
1923........	147	214	153	135	166	122	134	149
1924........	143	218	154	134	165	118	133	150
1925........	151	223	159	146	165	110	159	164
1926........	146	229	156	136	170	105	155	176
1927........	139	231	154	131	173	99	147	163
1928........	143	232	156	139	169	96	154	147
1929........	141	236	155	138	169	94	151	161
1930........	126	226	146	117	154	90	129	130
1930								
January...	136	234	153	134	158	....	141	159
February..	135	231	152	131	....	....	136	114
March.....	133	235	151	126	....	90	132	131
April......	132	231	151	127	158	....	136	135
May.......	130	228	150	124	....	....	132	128
June.......	127	227	149	123	....	....	131	138
July.......	123	224	148	111	155	....	123	134
August....	123	224	147	108	....	....	125	116
September.	123	227	146	111	....	....	129	126
October....	121	220	144	106	147	....	125	133
November.	117	215	142	103	....	....	122	124
December..	114	216	139	97	....	....	112	119
1931								
January...	112	212	137	94	133	....	115	115
February..	110	215	136	90	....	....	98	85
March.....	109	219	134	91	....	82	100	104
April......	107	215	133	91	119	....	103	97
May.......	104	211	130	86	....	....	98	90
June......	102	207	129	80	....	....	93	93
July......	102	207	128	79	115	....	86	86
August....	102	207	127	75	....	....	87	90
September.	101	205	127	72	....	....	83	87
October....	....	....	....	68	116	....	78	86

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 484. Studies on the Reaction of Greenhouse Soils to the Growth of Plants, by W. W. Wiggin and J. H. Gourley. This bulletin deals with hydrogen-ion concentration as it is related to greenhouse flowers and ornamentals.

Bulletin 485. Land Utilization in a Southeastern Ohio County, by J. H. Sitterley, H. R. Moore, and J. I. Falconer. Marginal land areas have become a source of concern because of farm abandonment, dilapidated buildings, a low tax base, and low standards of living. The increasing necessity of state aid for public institutions has prompted study of conditions.

Bulletin 486. The Garden Symphylid, *Scutigerella immaculata* Newport, by G. A. Filinger. This bulletin presents a description, life history, and control measures for this pest which has recently become of great economic importance in greenhouses and truck fields.

Bulletin 487. The Propagation of Flowers by Cuttings and Seeds, by W. W. Wiggin. Results of 3 years' work on type of media, treatment of the media, degree of trimming, and location of the cut in the propagation of flowers by cuttings and on several phases of propagation by seeds are reported herein.

Bulletin 488. Improving Corn and Tankage for Pigs Not on Pasture, by W. L. Robison. This bulletin presents the results of tests of a number of supplements to corn and tankage for feeding to pigs in dry lot or under winter feeding conditions.

Bulletin 489. Movement of Open Country Population in Ohio, by P. G. Beck and C. E. Lively. This bulletin is concerned with the territorial movements and occupational changes of 1589 boys and girls who were reared in the open country of Ohio.

Bulletin 490. Feed Grinder Investigations, by E. A. Silver. This bulletin gives in detail studies with the two general types of electrically-driven feed mills with reference to construction, efficiency, and fineness moduli to be desired.

Bulletin 491. The Combined Harvester-Thresher in Ohio, by E. A. Silver and J. H. Sitterley. Studies on construction and adaptability of the combined harvester-thresher to Ohio conditions, as well as suggestions for meeting the straw problem, are reported.

Bulletin 492. Foods Used by Rural Families in Ohio During a Three-year Period, by Hughina McKay and Mary Ann Brown. In this bulletin the foods used by 113 farm families have been evaluated as to adequacy of the diet, cost of foods purchased, and value of foods produced on the farm for use in the home.

Bulletin 493. Celery Fertilizer Experiments in Ohio, by Donald Comin. Data on the nutrient requirements of celery grown on muck are presented to show the relative response of this crop to a number of specific treatments.

The Bimonthly Bulletin

Mar.-Apr., 1932 Number 155

Ohio Agricultural Experiment Station

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

The 1932 model egg factory at the Ohio Experiment Station, Wooster

SOME OBSERVATIONS ON CAGED LAYERS

D. C. KENNARD AND V. D. CHAMBERLIN

The trend of modern poultry keeping of recent years has been constantly towards intensification and confinement, to permit the application of business principles and factory methods to the poultry industry and avoid the ills of range contamination. The first accomplishment was to brood chicks successfully in confinement and to confine the layers indoors. Then followed the return of large capacity, permanent, hot-water-heated brooding plants, battery brooders, multiple floor or apartment laying houses, and now it seems the next radical development is rapidly taking form—the confinement of layers in individual wire cages.

Fig. 1.—These birds had been in cages 30 inches square, with wire bottoms, two and one-half years when photographed.

The Ohio Experiment Station began preliminary tests in 1924 with layers kept in wire cages 30 inches square, four birds to the cage. These tests have been continued during the past 7 years and have yielded some interesting results. One of the original layers lived until October 16, 1931, lacking 3 weeks of having spent 7 years in the cage. During this time she laid 544 eggs, 95 of which were laid during the seventh year. Of the 16 layers started in the first tests only 2 died during the first 3 years. This becomes more significant when compared with the 15 to 30 per cent loss of similar pullets during the first year under the usual conditions of management. Eight inferior pullets laid 112 eggs per bird the first year, and a similar number better quality pullets laid 144 eggs. The first 3 years' average total production for the inferior birds was 262 eggs per bird and that of the better grade layers was 335.

Tests with layers in individual cages 18 inches square were started in 1926 and continued for 3 years, with results comparable to the first tests with the birds in groups of four to the cage.

From these preliminary tests with a comparatively small number of birds it was observed among other things that hens kept in wire cages laid well and produced strong-shelled eggs with practically no loss from breakage, that the mortality of birds appeared to be less, that roosts or nests were not essential, that wire-screen floors did not make the hen's feet sore or affect them in any way even during a period of 7 years, and that the birds were apparently comfortable, happy, and contented.

Fig. 2.—This hen, one of four placed in the cage November 7, 1924, lived 7 years, less 3 weeks, in the cage and laid a total of 544 eggs, 95 of which were laid in 1931.

In the meantime, progressive poultrymen have become interested in the commercial possibilities of caging the layers, particularly in New Jersey where there are now a number of installations of individual hen batteries with a capacity of 1,000 or more layers. Obviously, no development of this kind could take place without the cooperation of manufacturers to provide suitable equipment. They have been alert to see the promising possibilities of this new method of management of the layers and have already made great progress in their efforts to design such equipment.

The poultry keepers who have made large installations of hen batteries are real pioneers, for they have done so on faith and hope with little or no experience, facts, or evidence to substantiate the venture. As in most primitive developments, mysteries and

secrets are rampant owing to the lack of definite and dependable information. This is especially true of feeding and is evidenced by the fact that a number of those who have hen batteries are placing their faith in "secret formulas". It is quite natural to suppose a special feed and method of feeding would be required for caged layers. This may prove true in time, but we know of no such information being available as yet.

NEW TESTS IN PROGRESS

Now that suitable equipment has become available, the Station is conducting tests to determine the commercial possibilities of individual hen batteries and to secure other information which can only be secured by observation and study of individual birds. The present work is being conducted with 254 layers in individual cages and 288 layers in groups of three in larger compartments.

TABLE 1.—Egg Production and Mortality of Caged Layers and Similar Birds in Laying Houses

Kind of layers	Per cent egg production by weeks												Mortality %
	1	2	3	4	5	6	7	8	9	10	11	Av.	
Leghorn pullets Group No. 1* Caged..	38.4	58.0	51.9	64.9	61.3	56.8	62.2	57.1	56.6	55.7	56.3	57.2	5.5
In laying house....	32.1	46.0	54.2	60.2	63.8	61.6	58.1	58.5	53.8	52.8	50.1	53.8	12.0
Leghorn pullets Group No. 2† Caged..	48.8	67.3	75.0	69.1	61.3	60.1	64.9	......	......	......	......	63.8	8.3
In laying house....	56.9	59.4	56.3	52.5	49.0	43.2	30.1	......	......	......	......	49.6	10.0
Rock-leghorn crossbred pullets* Caged	67.3	70.2	73.2	72.0	72.0	67.9	68.5	......	......	......	......	70.2	None
In laying house....	58.2	64.5	63.5	65.5	67.1	66.7	64.7	......	......	......	......	64.3	10.0

*November 12 to January 27, 1932.
†December 10 to January 27, 1932.

The pullets in individual cages were transferred from the range in October and the majority was kept confined in 10 x 12 colony houses until December 7, when they were moved to the cages. It will be observed from Table 1 that no loss of egg production followed the transfer to the cages, although one group was above 60 per cent in production and those laying less immediately increased production. As a precaution against reduced production or molt,

whole corn and wheat were fed liberally during the first 2 weeks, in addition to the regular all-mash feed. Apparently, the procedure proved effective.

The caged layers laid somewhat better and the mortality was less than that of similar birds upon the same rations in laying houses. Owing to the limited duration of the tests, the results are only speculative and should be considered as such.

The loss of eggs from breakage has been insignificant. The wire floor of the cage slopes to the outside so that the egg rolls out into a receptacle where it is protected against breakage and soilage. However, the wire floor did not solve the problem of soiled eggs. In some instances the wire became soiled with moist droppings which were spread over a considerable part of the floor by the bird's feet. When an egg was laid it became more or less soiled or streaked as it came in contact with and rolled over the wire. This was more true in the case of some birds than with others; certain rations tend to aggravate this condition.

A careful examination of 1586 eggs from the individual hen batteries showed that 12.7 per cent was soiled, and of 1920 eggs collected at the same time from similar pullets on the same ration in the laying houses, 10.7 per cent was found to be soiled. Of course, the percentage of soiled eggs is a variable factor and depends upon the standards by which the eggs are graded. Hence, the figures given can be interpreted to mean that there was little difference in the number of soiled eggs whether they came from the cages or the laying house.

Some of the advantages suggested thus far in favor of caging the layers are: the seemingly lessened mortality of layers and the accurate individual egg record which is automatically secured without involving the usual labor and time-consuming ordeal of trapnesting which, at best, is more or less inaccurate. Another distinct advantage is that when something goes wrong with a bird her condition can be promptly observed while she is yet in good physical condition. Often such birds have a market value when promptly observed; whereas later they often become a total loss.

FEEDING[1]

Will caged hens require a special ration for the best results? Will the amount of fiber and protein need to be more or less than usual?

[1]For rations and methods of feeding write to the Ohio Experiment Station, Wooster.

The new tests now in progress were designed to secure information on such questions. A preliminary test in 1925 with four layers to the cage would seem to indicate a high toleration for protein, at least so far as livability is concerned. Four cages each of four inferior pullets received an all-mash ration containing 7, 14, 28, and 56 per cent of a 75 per cent protein meat meal. This was equivalent to 17.3, 21.5, 29.2, and 46.2 per cent of protein to total feed intake. There was no mortality of birds during the period of the test, which was one year. The total egg production for each group of four was 422, 472, 325, and 260, respectively. Owing to the small number of birds, this does not indicate which amount of protein was best, except that the largest amount was evidently beyond the optimum for egg production. The significant point is that all four of the pullets confined in a cage or anywhere else could live a year on a 46.2 per cent protein ration. They all appeared to be in a good state of health and vigor to the end of the test. The only noticeably abnormal condition was the liquid condition of their feces. The average body weights of the birds recorded at seven intervals during the year were 2.70, 3.07, 3.10, and 3.14, respectively. This was contrary to the popular idea that a better maintenance of body weight results from more grain and less protein. The low body weights indicate the inferiority of the pullets in question.

Fig. 3.—One unit of egg factory.

Some of the layers on test in batteries of individual wire cages at the Ohio Station.

SIZE OF CAGES

In one of the tests 24 leghorn pullets are confined in individual cages 9 x 18 inches, or half the usual size. Their egg production from November 12 to January 27 averaged 58.33 per cent; whereas that of similar pullets in the regular cages, 18 inches x 18 inches, was 56.06 per cent and of those in the laying house was 53.75.

Should it prove that the layers, especially the lighter breeds, can be successfully restricted to the smaller space it would result in a material reduction of the cost of overhead expense of housing and caging the layers.

BARNS FOR LAYERS

Many poultrymen have remodeled their barns to make satisfactory quarters for the layers. Should individual cage batteries prove successful, barns and other buildings could be used to advantage for housing the caged layers. Well-built barns can usually be remodeled and heated to keep the temperature from going much below 40 degrees Fahrenheit without involving a great deal of expense. In some instances, no doubt, the barn could be remodeled, the needed heat provided, and cages installed at an expense comparable to that required for building a modern laying house, especially since an additional 25 per cent or more layers can be accommodated in the hen batteries on a given floor area.

EXPECTATIONS

Since so little information is yet available, caging the layers is attended with many hopes and expectations yet to be substantiated. The evidence thus far would seem to indicate that the production of layers in cages should at least prove comparable to similar birds in the usual laying house. Perhaps the question of reduced loss of birds from various causes offers the more promising possibilities. Certainly, the last word in sanitation can be most effectively attained with the layers in cages. This may lessen mortality from certain causes. Losses from cannibalism are avoided. These losses have become an ever increasing menace attending the present methods of managing the layers. Surveys reported from a number of states indicate the yearly average losses from this cause alone to be from 5 to 8 per cent of the pullets going into the laying house. A California poultryman reports that he has been handling leghorn hens exclusively for many years but that feather picking and pick-outs are overcoming the business, and he states that if it keeps increasing in that section as rapidly in the next few years as in the past 2 or 3 years the poultry business will be greatly hampered. In New Jersey, a commercial poultry plant was recently visited where losses from pickouts had brought the poultryman nearly to the point of desperation. The wife spent most of the day with

catching hook in hand looking for new victims of cannibalism which were constantly occurring. This poultryman was installing individual hen batteries as a last resort to save the remainder of his flock and avoid having to give up his business. Although individual hen batteries afford 100 per cent protection against the losses from cannibalism, this is not altogether true of feather picking. Occasionally, an individual hen may pick her own feathers, as was the case with the bird shown in Figure 4. Had this hen not been confined to an individual cage one would never have suspected her of picking her own feathers. She spent 2 to 3 months each year growing a new coat of feathers; then she amused herself the remainder of the year picking them off.

Fig. 4.—An extreme case of feather picking and eating.

Confining the layers in batteries of individual wire cages affords new and promising possibilities for near-future accomplishments in poultry keeping. It seems probable that this new method of managing the layers will aid in the solution of a number of our present problems; at the same time, we may expect new problems to be introduced, the nature of which will finally determine the degree of success that can be realized from the innovation. Results secured thus far have been favorable.

RATIONS FOR LAYERS

D. C. KENNARD

What is the best ration for layers continues to be one of the most frequent inquiries of poultry keepers. In reality, there is no best ration for all. What is best for one may not always be best for another. It should be remembered that there are countless combinations of feed stuffs which may prove about equally effective. However, there are certain fundamental requirements around which every successful ration must be built.

It is what goes below the Base Line (Table 1) that largely determines whether a ration is good or poor, for here we have the special supplements which provide the essential proteins, minerals, and vitamins. The proper sources, combinations, proportions, and quality of these vital nutritional factors make the best ration. Since these are not always readily available many prefer the use of prepared poultry feeds.

TABLE 1.—Rations*

Ingredients and numbers

Ingredients	Ration numbers			
	1	2	3	4
Yellow corn, coarsely ground	35	....	55	15
Winter wheat, coarsely ground	20	55	....	20
Oats, ground, 32–35 lb. per bu.	20	20	20	20
Oats, whole, 32–35 lb. per bu.	....	....	....	20
▪ Base Line ▪				
Wheat bran	5	5	5	5
Alfalfa leaf meal	5	5	5	5
Meat scraps, 50–55 per cent protein	8	8	8	8
Dried skimmilk	5	5	5	5
Oyster shells, chick size	2	2	2	2
Salt	0.5	0.5	0.5	0.5
Cod-liver oil	1	1	1	1

Oyster shells or limestone grit and chopped legume hay always available.

*These experimental rations are not suggested for general use. Rations better suited for practical purposes will be sent upon request.

Rations have often been built around tradition and popular opinion; for instance, wheat is supposed to increase mortality, and corn is fed instead of wheat or oats to keep up body weight. Popu-

lar opinion seems about equally for and against oats for layers, and there is considerable prejudice against whole oats on account of the hulls. What happens when we put these contentions to actual test is shown by the preliminary, though not conclusive, results of a test now in progress at the Station.

This test involves four groups of 50 January-hatched white leghorn pullets carefully selected for uniformity of each group. The all-mash ration received by each group and the results therefrom are given in Tables 1 and 2.

TABLE 2.—Results

Egg production, body weight, feed consumption, and mortality
July 1 to December 23, 1931

Ration number	Eggs	Average monthly weight	Pounds feed	Mortality
	Per bird	*Per bird*	*Per bird*	*Per cent*
1. Control	61	3.50	33.91	24
2. Wheat instead of corn	57	3.54	35.02	10
3. Corn instead of wheat	60	3.54	33.14	20
4. Oats, 40 per cent	65	3.49	35.56	14

The control ration (No. 1) has proven quite effective over a period of years. It may be considered as a conservative, well-balanced formula without extras. Suppose wheat is substituted for all of the corn (Table 1, Ration 2) or all of the wheat replaced by corn (Ration 3), what would be expected in egg production, body weight, and mortality? See Table 2. Contrary to popular opinion, there was no significant difference in egg production, body weight, or mortality. Perhaps, the use of wheat instead of corn would be attended with greater mortality if the ration were not supplemented with other sources of vitamin A, such as green feed, legume hay, and cod-liver oil, since yellow corn is a good source of vitamin A and wheat is not. Certainly, a wheat ration deficient in vitamin A would prove unsatisfactory; whereas, if yellow corn instead of wheat were used, the ration would be much improved. But, if the wheat ration is adequately supplemented with vitamin A from green feed, legume hay, or cod-liver oil, it appears from the results of the test in question that either corn or wheat may be used to equal advantage. However, as a general practice, it would be preferable to include both corn and wheat in the ration for layers.

The value of oats in the laying ration has been a much debated question. According to 4 years' extensive tests at this Station, oats may well be considered a part of the laying ration (See Bimonthly Bulletin, Sept.-Oct. 1930). In fact, the results of these tests would justify oats being placed below the Base Line along with the essentials to be included in all laying rations. For instance, suppose the oats in the control ration (No. 1) is replaced by that amount of corn, making a total of 55 per cent corn. In every case, such a ration proved inferior to a ration containing 20 per cent oats. Since the laying rations containing 20 per cent oats invariably proved superior to a similar ration without oats, we wondered how much more oats might be advantageously used. Accordingly, 20 per cent whole oats was added to the control ration (1) and the corn was reduced to 15 per cent. This gave Ration No. 4 (Table 1) and the results in Table 2. The results give no indication of having exceeded the optimum amount of oats. In fact, when 40 per cent of the total feed intake was oats, better results were secured than from only 20 per cent. A similar test the previous year also corroborated the results of the present test. Judged by popular opinion and general practice, Ration 4 would seem clearly out of the question, but by actual test it has proven one of the best.

We may well ask again what, then, does make the best ration? It is what goes below the Base Line that determines, for the most part, the merits of a ration; it seems that the value of the laying ration is not affected by the proportion of corn to wheat and that either of these grains may be successfully used to the exclusion of the other provided the essential proteins, minerals, and vitamins are adequately supplied.

SUN YARDS FOR CHICKENS

D. C. KENNARD AND V. D. CHAMBERLIN

The outdoor range has been blamed for many of the present ills from intensified poultry keeping. Intensification is often attended with disease and parasitic complications which make the natural range hazardous because of no effective means of prevention or control of soil contamination. In their effort to solve the range problems, many poultrymen have of late years resorted to the use of sun yards, sun porches, or to confinement of the birds indoors.

Sun yards or sun porches have the advantage, over confinement of the birds indoors, of permitting a larger number to be kept in a given brooder house and at the same time of enabling them to receive the benefits of direct sunlight.

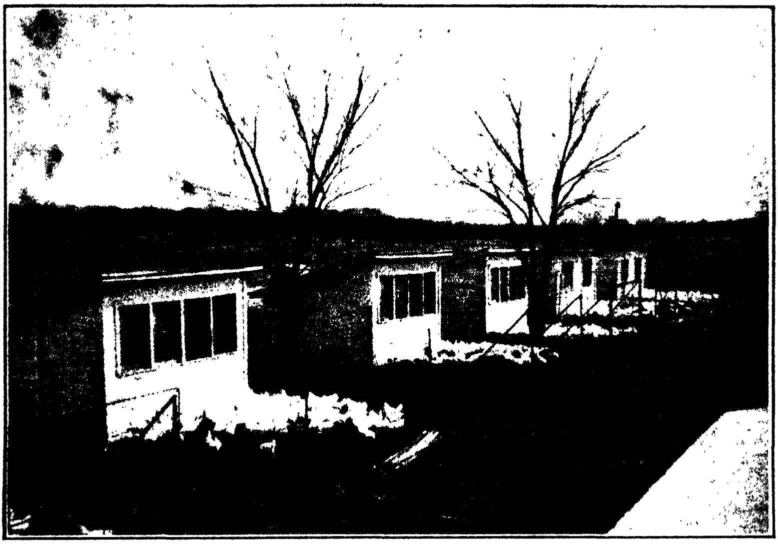

Fig. 1.—January-hatched pullets confined to cinder sun yards at the Ohio Experiment Station. This has proven an effective and economical procedure for the prevention of the hazards of contaminated soil.

Wire-screen sun porches have the advantage of being self-cleaning and more sanitary than sun yards because the birds are not permitted to come in contact with the droppings. The tops, sides, and ends may be enclosed with 1- or 2-inch mesh netting, but the floor should be of ¾-inch square mesh number 15 or 16 gauge wire hardware cloth. The floor is supported by 1 x 4's edgewise, 2 feet apart, and 6 to 12 inches off the ground.

Sun yards may be made of concrete, cinders, slag, crushed stone, or coarse gravel. Concrete yards have certain advantages but require daily flushing with water which, in practice, is often neglected. Cinder and slag sun yards are often less expensive, especially the initial cost, and are preferable to crushed stone or coarse gravel. The cinders should be as coarse as can be obtained, or, if slag is used, it is preferable to use the kind intended for road construction which is graded into pieces 1 to 1½ inches in diameter.

In coal mining sections of the State, refuse coal may be used. This was done at the Station's Southeastern Experiment Farm, Carpenter, Ohio, and proved quite satisfactory.

PREPARATION OF A CINDER OR SLAG SUN YARD

The practice of the Station at Wooster has been to fill in with the cinders, slag, or other material to a depth of 8 to 10 inches on top of the ground over an area about the same as that of the inside floor space of the brooder house. If the top of the enclosure is covered, 24- to 36-inch wire may be used for the sides and ends, or, if it is desired to leave the top open, then the sun yard may be enclosed with poultry netting 6 feet high.

When conditions seem to warrant it, 3 or 4 inches of fresh cinders or slag may be put on top of the previous fill. If the fill finally becomes too high, then it can be removed for making roads or walks and a new fill of fresh material can be again put on the original ground level, as in the beginning.

FATTENING CALVES IN DRY LOT VERSUS PASTURE

PAUL GERLAUGH

Thirty-two steer and heifer calves, including 12 Aberdeen-Angus, 12 Herefords, and eight Shorthorns, were used in the test. The Angus were bred at the Experiment Station, the Herefords at the Mahoning County Experiment Farm, and the Shorthorns at the Holmes County Farm. Most of the calves were born during October and November, although a few December calves were included.

Lot 1 was fed in a barn that provided good ventilation but there was no outside lot. Mixed hay and corn silage provided their roughage. A mixture of equal parts cottonseed meal and linseed meal made up the protein supplement for both lots; it was fed at the rate of 1½ pounds per calf per day to each lot throughout the test. Shelled corn was full fed to this lot.

Lot 2 was turned into a pasture of about 12 acres. About half of this area was a permanent blue-grass sod; the other half was a mixture of alsike clover and blue grass of 2 years' standing. This lot was fed in an open shed located at the edge of the pasture. These calves were fed about half as much corn as the calves in Lot

1 consumed until late in July, when the pasture had passed its peak. After August first the calves were full fed corn, although there was an abundance of grass available.

Pigs followed each lot of calves and were fed protein supplement but no corn.

The feed valuations are possibly subject to some difference of opinion. Valuing pasture at 5 cents per calf per day, or $8.40 for the season, makes an excellent return for the pasture but a handicap on the returns from the calf. The silage and hay consumed per calf, in the dry-lot group, amounted to $6.08 at the prices shown at the foot of the table. On most farms the pasture charge would not be considered as great as the value of the silage and hay.

A cattle salesman from the Cleveland Stock Yards appraised the cattle at the close of the test. The difference of $2.00 per cwt. was said to be greater than ordinarily prevails between similar groups at that season of the year. The calves in Lot 2 were not fat enough to command special attention, and their long and heavy hair coats may have over-emphasized this point.

After the test closed, seven Angus heifers were removed from the lots and saved for herd replacements. The three Hereford heifers that had been in the dry lot were sold for $10.00 per cwt. to an Akron butcher. The remaining cattle were grouped together in the barn and full fed for an additional 6 weeks and then sold. During this period, the calves that had been on pasture improved their appearance in thickness of flesh more than the calves that had been fed in the dry lot throughout the test. Keeping the calves in the dry lot materially improved the sleekness of the hair coats of the lot that had been on pasture. An Akron butcher bought the entire group for his Christmas beef trade. Fifteen steers sold for $10.25 per cwt. and the remaining four steers and six heifers at $9.50. The cattle proved very satisfactory to the butcher. The differences in thickness of flesh which existed at the close of the pasture season were not apparent when the carcasses were seen in the coolers.

The feeding period following the close of the test was very much worthwhile from a financial point of view. The fact that the calves were comparatively light in weight at the close of the test, together with the lack of "finish" on the pastured-fed calves and the approach of the Christmas market season, would probably justify similar procedure in most cases.

This was our first experience in using fall calves for summer fattening work. It would be difficult to obtain this age of feeders through the regular market channels, as a great majority of the

good-quality calves offered at the markets are born during the spring season. Calves of the age and weight used in this experiment require a longer feeding period to reach a desirable market finish than do older cattle. When they were well finished their weight was very popular for many local butchers and it would not have been difficult to have disposed of them in several different places. The heifer calves did not have sufficient weight to be severely discounted.

Fall-dropped calves require that their mothers be given more feed during the winter time than when the calves are born in the spring. There is less use made of pasture and more extensive use made of feed in winter quarters. Our first experience leads us to think that there is considerable merit to the plan of having the calf crop dropped during the fall months if feed and equipment are available to care for the cow herd properly.

TABLE 1.—Pasture Versus Dry Lot for Fattening Fall-dropped Calves, 1931

May 19-November 3 on test

	Lot 1 Dry lot	Lot 2 Pasture
Number steer calves per lot	10	9
Number heifer calves per lot	6	7
Market value at start of test	$ 8.00	$ 8.00
Average weight of calves, May 19 lb.	428	428
Average weight, Nov. 3 lb.	755	746
Average daily gain of all calves lb.	1.94	1.89
Average daily gain of steer calves lb.	1.98	1.97
Average daily gain of heifer calves lb.	1.89	1.79
Average daily ration, lb.:		
Shelled corn	10.4	7.5
Protein supplement*	1.5	1.5
Silage	10.0	....
Mixed hay	1.5	....
Pasture	....	Pasture
Feed required per cwt. gain, lb.:		
Shelled corn	534	398
Protein supplement	77	79
Silage	513	....
Mixed hay	77	....
Pasture	....	Pasture
Cost per cwt. gain	$ 9.71	$ 8.81
Necessary selling price	$ 8.74	$ 8.34
Gain on pigs following cattle	508	631
Necessary selling price (pork credited)	$ 8.49	$ 8.02
Market appraisal, Nov. 3 (Cleveland basis)	$ 9.50	$ 7.50
Returns per bu. corn, at close of test, pork credited	$ 0.94	$ 0.52
Profit or loss per calf, at close of test, pork credited	$ 7.64	$-3.93

*Protein supplement equal parts linseed and cottonseed meals.

Prices used: shelled corn, $0.70 per bu.; protein supplement, $30.00, silage, $5.00, hay, $15.00 per ton; pasture 5 cents per calf per day; hog gains $6.00 per cwt.

As to feeding the calves in dry lot as compared to pasture, our results would indicate that if the pasture is available it will make a good return, although a longer feeding period is necessary. Some time would have been saved but more grass wasted had we fed

larger amounts of corn during the first 2 months on pasture. We did succeed in having a very desirable product ready for the holiday trade by the system which was followed in handling both lots of calves, and we believe that a farmer could follow either of the systems and expect satisfactory results. If the plan of feeding on pasture is followed, it is essential to remember that the calves must be fed grain on pasture, and full feeding of grain should start not later than the first of August, if a really choice product is to be secured by the middle of December.

TWO YEARS' FEEDING OF MANAMAR TO A HERD OF DAIRY COWS

C. F. MONROE AND W. D. MAHAN

Manamar is a comparatively new feed on the market in the class of high-protein supplements. Its ingredients, as stated by the manufacturers, are fishmeal, dried kelp (a sea weed), limestone, and salt. From an experimental standpoint, Manamar is interesting because it contains an animal protein, organic and inorganic mineral matter, iodine, and vitamin D. Because of these factors Manamar has been considered by some as a tonic feed and as somewhat of a preventive of reproduction troubles. It seemed desirable to get some information on this feed under experimental conditions, since it was being sold in Ohio in rather large quantities.

The Manamar used in this work analyzed 32 per cent protein and 37 per cent ash.

The dairy herd at the Belmont County Experiment Farm was used in making this test. At the start of the experiment, November 1, 1928, the herd, consisting of 14 cows, was divided as evenly as possible into two groups. Both groups were treated alike in all respects, with the exception that one group received a grain mixture containing 10 per cent of Manamar. The check group received practically the same grain ration with a mixture of cottonseed meal, bonemeal, and salt, instead of the Manamar.

This herd was fed and managed as an ordinary, good, farm herd. In summer, the cows were on pasture but received grain in accordance with the condition of the pasture and the milk produced. In winter, a mixed hay was fed with corn silage.

The herd was positive to the test for abortion.

RESULTS

MILK PRODUCTION

Because it was desired to get some measure of the health effect of Manamar, it was necessary to feed the experimental rations continuously to the respective groups rather than to alternate them at 60- or 90-day periods. Since it is hardly possible to get two groups of cows exactly comparable in milk production, the following plan of comparison was adopted. The production of the individual cows in the two groups was compared with their production in the lactations preceding the start of the experiment. In this way, each cow is considered as her own check. This was possible because all the cows had been fed alike, on a ration very similar to the check ration. Owing to irregularities in lengths of the various lactations, comparable periods in the lactation for each cow have been used. The results of this comparison are shown in Tables 1 and 2.

Both groups increased in milk production from the pre-experimental to the experimental period, the net increase of the check group being 9 per cent and of the Manamar group 19.7 per cent. This difference is apparently decidedly in favor of the Manamar group; however, it is largely to be accounted for by Cow 58 in the Manamar group. This cow increased from an average daily production of 18.8 pounds to 30.5 pounds, or a 62 per cent increase. The increase made by this cow is as great as the combined increase of the other six cows in the group. On the other hand, the comparatively poor showing of the check group is brought about by Cow 108, which aborted twice. This cow showed a 39.8 per cent decrease. If the production figures for these two cows were eliminated from the data, the comparison would be decidedly in favor of the check group. On the basis of this comparison, the feeding of Manamar has not been accompanied by a statistically significant increase in milk production.

TABLE 1.—Pre-experimental and Experimental Production, Check Group

Cow	Period	Pre-experimental			Experimental			Difference*	Difference*
		Freshening	4% milk daily	Av. 4% milk	Freshening	4% milk daily	Av. 4% milk		
No.			*Lb.*	*Lb.*		*Lb.*	*Lb.*	*Lb.*	*Pct.*
59	2nd-8th months	Normal Normal	21.62 21.54	21.58	Normal Normal	20.60 22.38	21.49	— .09	— .42
81	2nd-6th months	Aborted	13.77	13.77	Normal Aborted	17.75 21.19	19.47	+ 5.70	+41.40
108	4th-8th months	Normal	28.24	28.24	Aborted Aborted	21.07 12.91	16.99	—11.25	—39.84
25	1st-7th months	Normal Normal	30.44 26.03	28.23	Normal Normal	27.97 27.80	27.88	— .35	— 1.24
89	1st-4th months	Aborted	19.37	19.37	Aborted Normal	25.58 28.82	27.20	+ 7.83	+40.42
55	4th-8th months	Aborted Aborted	18.65 18.97	18.81	Normal Normal	19.59 25.46	22.52	+ 3.71	+19.72
39	1st-7th months	Aborted Normal	25.43 38.63	32.03	Normal Normal	38.39 43.95	41.17	+ 9.14	+28.54
Total		......	......	162.03	......	......	176.72	+14.69	......
Average		......	......	23.15	......	......	25.25	+ 2.10	+ 9.07

*— favors pre-experimental production; + favors experimental production.

TABLE 2.—Pre-experimental and Experimental Production, Manamar Group

Cow	Period	Pre-experimental			Experimental			Difference*	Difference*
		Freshening	4% milk daily	Av. 4% milk	Freshening	4% milk daily	Av. 4% milk		
No.			*Lb.*	*Lb.*		*Lb.*	*Lb.*	*Lb.*	*Pct.*
54....	2nd-8th months	Normal Aborted	18.38 17.17	17.77	Normal Normal	20.57 19.05	19.81	+ 2.04	+11.50
70.....	1st-7th months	Normal	34.14	34.14	Normal Normal	30.96 32.90	31.93	− 2.21	− 6.50
106.....	1st-7th months	Normal	35.50	35.50	Normal Normal	31.66 32.51	32.08	− 3.42	− 9.60
85.....	2nd-8th months	Aborted	14.30	14.30	Normal Normal	17.65 16.27	16.96	+ 2.66	+18.60
65.....	1st-3rd months	Normal Normal	17.17 29.07	23.12	Normal Aborted	32.08 28.31	30.19	+ 7.07	+30.60
58.....	1st-7th months	Normal Aborted	22.02 15.70	18.86	Normal Normal	31.28 29.89	30.58	+11.72	+62.10
73.....	1st-7th months	Aborted Aborted	26.36 26.84	26.60	Normal Normal	28.28 28.32	28.30	+ 1.70	+ 6.40
Total		....	....	170.29	....	....	189.85	+19.56	....
Average		....	....	24.33	....	....	29.12	+ 4.79	+19.7

*— favors pre-experimental production; + favors experimental production.

Another comparison of the milk production of the two groups has been made by comparing the first and second lactation productions during the experiment. These figures are presented in Table 3.

TABLE 3.—Comparison of First and Second Lactations on Experiment for Cows Fed Check Ration and Manamar Ration

Check			Manamar		
	Lactation			Lactation	
Cow	First	Second	Cow	First	Second
	4% milk daily	4% milk daily		4% milk daily	4% milk daily
	Lb.	*Lb.*		*Lb.*	*Lb.*
59	20.60	22.38	54	20.57	19.05
81	17.75	21.19	70	30.96	32.90
108	21.07	12.91	106	31.66	32.51
25	27.97	27.80	85	17.65	16.27
89	25.58	28.82	65	32.08	28.31
55	19.59	25.46	58	31.28	29.89
39	38.39	43.95	73	28.28	28.32
Total	170.95	182.51		192.48	187.25
		Increase 11.56 Increase 6.8%			Decrease 10.23 Decrease 5.3%

By this comparison, it will be seen that the cows on the Manamar ration decreased 5.3 per cent; whereas those on the check ration increased 6.8 per cent. These results would support the opinion expressed in the previous paragraph that Manamar did not increase the milk production.

REPRODUCTION

In the 2 years preceding the start of the experiment, there were five abortions in each group. During the experimental feeding period, there were four abortions in the check group and only one in the Manamar group. One of the cows in the check group aborted twice. While this difference in abortions appears to favor Manamar feeding, the number of observations has not been sufficiently large to preclude the possibility of chance in this matter. Two heifers fed on the Manamar ration also aborted, as well as one heifer on the check ration. These abortions on the Manamar ration indicate that it is possible for cows so fed to abort. The blood test of the cows used in this experiment remained unchanged, regardless of the feeding.

BREEDINGS

Table 4 lists the breedings required per conception during the first experimental lactation. The breedings required per conception during the second experimental lactation are not shown because the herd was sold off before all these cows had freshened. In the check group, 13 breedings were required for seven conceptions. In the Manamar group, eight breedings were required for seven conceptions. Six cows in the latter group had perfect breeding records, and five in the check group had perfect breeding records. One cow, 108, in the check group, required five breedings before conception. This cow had aborted just previously. It is this one cow that largely accounts for the difference between these two groups. The weights of the calves dropped in the two groups were practically the same.

TABLE 4.—Breedings per Conception and Birth Weight of Calves

Check				Manamar			
Cow	Breedings	Calf Sex	Calf Weight	Cow	Breedings	Calf Sex	Calf Weight
	No.		*Lb.*		*No.*		*Lb.*
59.......	1	Female	57	54....	2	Male	42
81.......	3	Male	52	70....	1	Male	53
108.......	5	Aborted		106....	1	Male	53
25.......	1	* Female	60	85....	1	Female	58
		Male	70				
89.......	1	Male	50	65....	1	Aborted	
55.......	1	Male	47	58...	1	Male	60
39.......	1	Female	65	73....	1	Male	73
Total	13	7			8	7	
Average	1.9	Female	61		1.1	Female	58
		Male	55			Male	56

*Twins.

In the Manamar group, there were three cases of milk fever; in the check group, there was one case. Two of the Manamar cows had more or less udder trouble following freshening; none of the check cows had any trouble in this way.

Although these cases of milk fever and udder trouble are not favorable to Manamar, the weight of evidence is certainly not sufficient to assume that Manamar caused these troubles.

A composite milk sample from the two groups showed no iodine in the milk from the check group and .17 milligrams of iodine per quart in that from the Manamar group.

This history of 2 years of Manamar feeding is presented to show what has happened during this time. While on the surface the results appear to favor Manamar, a careful interpretation, in

the light of the check group, indicates that the Manamar had little influence. As a straight feeding proposition, Manamar compared favorably with the mixture of cottonseed meal, bonemeal, and salt, which it replaced. This latter mixture, however, is much cheaper than Manamar.

SOWING SWEET CLOVER IN WINTER WHEAT

C. J. WILLARD, L. E. THATCHER, AND J. S. CUTLER

In many sections, good stands of sweet clover have been difficult to obtain in winter wheat. When scarified sweet clover is sown early, as red clover is, it may germinate promptly, and, if hard freezes come later, the seedlings are killed. If seeding is delayed too long, the sweet clover seedlings must compete with a well-established and rapidly growing wheat crop.

TABLE 1.—Comparing Sweet Clover Seed In-the-hull with Scarified Seed on Wheat—Wooster

Plot No.	Kind of seed	Approximate date of sowing	Yields 2nd year hay			3-year average
			1929	1930	1931	
			Lb.	*Lb.*	*Lb.*	*Lb.*
1	Unhulled	Oct. 1 (with the wheat)	8130	5010	4650	5930
2	Scarified	Oct. 1 (with the wheat)	1980*	1950*	1440*	1790
3	Unhulled	Late December	8880	4710	4320	5970
4	Scarified	Late December	1710*	4320	2370*	2800
5	Unhulled	March 10	5910	4410	4290	4870
6	Scarified	March 10	2370†	4740	4500	3870
7	Unhulled‡	May 1	5250	4290	3780	4440
8	Scarified‡	May 1	5160	4620	3270	4350

*Mostly weeds.
†Stand thin but mostly sweet clover.
‡Seed harrowed in—others broadcast only.

Because of the good results obtained elsewhere with the unhulled seed as harvested, experiments with this kind of seed were started at Wooster and Columbus in the winter of 1927-1928. Tests were conducted on three of the outlying farms in 1929-1930, and on seven in 1930-1931. The experiments at Wooster have been very favorable to using this kind of seed, as evidenced by the data in Table 1.

TABLE 2.—Seeding Sweet Clover, Columbus

Summary of stands or other comparisons, methods of seeding sweet clover in wheat

Approximate date of seeding	Kind of seed	Method of seeding	Approximate rate per acre	Cultipacked	1928 Plants per sq. yd. Aug. 15	1929 Notes Aug. 28	1930 Plants per sq. yd. Aug. 9	1930 Plants per sq. yd. Apr. 27, 1931	1930 Yield per acre tops and roots Apr. 27, 1931
			Lb.		*No.*		*No.*	*No.*	*Lb.*
October 1	In-the-hull	Drilled	20	No			23		
January 1	In-the-hull	B. C.	20	No	77		18		
January 1	Dehulled	B. C.	12—16	No			18		
February 1	In-the-hull	B. C.	20	No		Good	6		
February 1	Dehulled	B. C.	12—16	No			10		
February 22	In-the-hull	B. C.	20	No	75	Good	22		
February 22	Dehulled	B. C.	12—16	No			33	40	720
February 22	Scarified	B. C.	12	No	63	Med.-Fair	36	42	680
{ March 6	Scarified	B. C.	6	No }			31	72	1060
{ April 1	Scarified	Drilled	6	No }					
{ March 6	Scarified	B. C.	6	No }			30		
{ April 1	Scarified	Drilled	6	Yes }					
March 15	In-the-hull	B. C.	20	No	96		43	100	1350
March 15	Scarified	B. C.	12	No	74		36	44	1040
April 1	In-the-hull	Drilled	20	No	48		27	44	940
April 1	In-the-hull	Drilled	20	Yes	47		22		
April 1	Scarified	Drilled	12	No	84		51	81	1350
April 1	Scarified	Drilled	12	Yes	66		46		
April 15	In-the-hull	Drilled	20	No	22	Fair	2	7	230
April 15	In-the-hull	Drilled	20	Yes	25	Fair	4		
April 15	Scarified	Drilled	12	No	62	Med.	14	26	430
April 15	Scarified	Drilled	12	Yes	90	Med.	10		

The unhulled seed has contained about 60 per cent of hard seed; the scarified seed only 2 to 10 per cent.

TABLE 3.—Seeding Sweet Clover, Outlying Farms

Method of Seeding Sweet Clover, Trumbull County Experiment Farm, 1930*

Plot	Date	Kind of seed	Rate per acre	Stand secured
			Lb.	
1	March 1 April 8	Seed in hull Scarified	20 6	Good Good
2	March 1	Seed in hull	20	Fair
3	April 8	Scarified	12	Good
4	April 22	Scarified	12	Fair to poor

*Sweet clover, both scarified and in-the-hull, was sown at the Trumbull County Experiment Farm on several dates in 1930, as described in Table 3. The seedings were made across the fertility plots in Block C. Tests made by Dr. Conrey in 1927 showed the pH to range from 5.84 to 6.50 on the 14 fertility plots, the check plot being the lowest. The scarified seed sown April 8 gave the best stands. On June 12, Plot 3 had a good stand, while Plot 2 appeared almost bare. The stand thickened up before fall. The later sowing of scarified seed gave markedly poorer stands.

The results at Columbus (Table 2) and on the outlying farms are more or less conflicting. Data from the Trumbull County Farm only are reported in Table 3. No yields of hay have been taken there, results being measured by the stands in the fall of the seeding year and, in some instances, by the yields of roots the following spring. The tests have included a considerable range of seeding dates, kinds of seed, and culture treatments; each test was somewhat different, and the data and observations can hardly be given here. Some general observations from them may be summarized as follows:

1. Sowing unhulled seed has not insured stands of sweet clover. Many good stands have been secured, but there have also been failures where scarified seed has given a stand.

2. In no one of these tests has unhulled seed sown late given a satisfactory stand, in contrast to Plot 7 at Wooster sown May 1.

3. Dehulled but unscarified seed has given slightly, but rather uniformly, better results than unhulled seed at all dates of sowing. This is important to the seed trade because it is almost impossible to clean and prepare a uniform product from seed-in-the-hull. Dehulled seed with a high hard seed content is now produced more or less accidentally but could be produced in a uniform, high quality product if there were a demand for it.

4. Cultipacking has not affected results with unhulled seed. It has increased the stand obtained from scarified seed when dry weather followed the seeding.

5. The best stands from dehulled or unhulled seed have been equal to, but not usually better than, the best stands from scarified seed.

6. There has been a distinct tendency at Columbus for March 15 to be the most favorable date for sowing unscarified seed. This may be due to open winters resulting in the germination and subsequent death of the seedlings from a larger proportion of the seeds sown early in the winter.

RECOMMENDATIONS

The following recommendations are somewhat tentative. Additional data obtained from future tests are necessary to confirm or modify them and will be reported from time to time as seems necessary.

The use of unhulled and dehulled sweet clover seed has given as good stands and yields as the use of scarified seed on winter wheat in a sufficient number of comparisons to justify the recommendation that sowing unscarified seed in the winter or very early spring be tried when difficulties have been encountered in securing a stand with scarified seed. However, unscarified seed should not be used after freezing weather is past. About March 15, in the latitude of Columbus, and April 1, in northeastern Ohio, are perhaps the latest satisfactory dates.

When good stands are obtained from unscarified seed, the yield is likely to be somewhat higher than from scarified seed because of the earlier establishment and consequent better growth of the former, enabling the sweet clover to compete more successfully with the rapidly growing wheat crop.

Scarified seed should be sown as early as the danger to the seedlings from freezes is past. In the latitude of Columbus, the most favorable date has been April 1, but sowing earlier than this is preferable to sowing later. The probability of securing a stand in wheat decreases very rapidly after April 1. At Wooster, the most favorable date is about April 15.

Unhulled sweet clover seed of good quality is hard to secure or produce, and dehulled unscarified seed with a hard seed content of 50 to 75 per cent is apparently as good as, or perhaps a little better for winter or very early spring sowing than, the unhulled seed and is a more satisfactory product for both seed dealer and purchaser. The hard seed content is the important consideration in winter seeding, whichever kind of seed is used.

If unhulled seed is used, it should be bought and sown by the pound, rather than by the bushel or quart. Fairly plump, unhulled seed will contain 20 to 28 per cent of hulls. Most of these tests with unhulled seed have used 20 pounds to the acre; less is rarely advisable. A seeding of unhulled seed will thus usually cost more than one of scarified seed.

While experimental evidence is still lacking, it seems probable from general experience that a combination seeding, sowing unscarified seed in late winter and following with scarified seed as early in the spring as the seed can be sown after heavy freezing weather is past, will result, over a period of years, in a larger percentage of satisfactory stands than using either kind of seed alone.

An objection to the use of unscarified seed is that it fills the soil with sweet clover seed. Not all the "hard" seeds in a sample germinate the year they are sown, regardless of the date of seeding. Possibly this is one reason for the variable results secured from the unscarified seed, since only the seeds which soften enough to germinate the season of sowing are valuable that year. The others remain in the ground and germinate over a period of many years, so that if alfalfa, red clover, or especially alsike for seed, is sown later in the rotation, the sweet clover may be a weed in it. If this occurs, clipping the new seeding about September 1 of the seeding year will weaken the sweet clover and lessen the damage.

LESPEDEZAS IN SOUTHEASTERN OHIO

S. C. HARTMAN[1]

Japanese lespedeza is becoming established in a considerable number of southeastern Ohio pastures. Numerous reports on its growth, together with inquiries as to its value and adaptability, seem to indicate increasing interest in this new legume. Earlier experiments showed that seedings often were unsuccessful and that

[1]Superintendent of Southeastern and Washington County Experiment Farms. The work was carried out through the cooperation of the Division of Forage Crops, U. S. D. A. The writer wishes to express his gratitude to M. A. Bachtell, Chief of the Division of District and County Experiment Farms, for making the study possible; to J. S. Cutler for aid in outlining and conducting the project; to L. E. Thatcher for supplying the data from Wooster; to C. J. Willard for the use of data obtained at Columbus; to the vocational agricultural instructors of district number 11 and to the county agricultural extension agents in the area covered by the study for cooperation in securing information from the questionnaires and for supervision of the tests; and to the many vocational agriculture students and farmers who cooperated in filling out the questionnaires and in making the tests.

the crop apparently had certain definite climatic limitations.[2] In an effort to determine the adaptation of the lespedezas, together with some of the factors limiting their growth, an extensive series of plantings was made in 1930 and 1931 in the pastures of southeastern Ohio. The seedings were preceded by a questionnaire which supplemented the information presented by Bailey[3]; the questionnaire was used in formulating plans for these tests. The tests were, for the most part, conducted by students of vocational agriculture and farm operators under the direction of vocational agricultural instructors and county agricultural agents. A total of over 600 plots was sown, seeding records were carefully made, and observations are being continued as to the development of the different lespedezas, as well as those factors favoring or discouraging establishment.

An adaptation map has been prepared (Fig. 1) which summarizes the results of the investigation up to, and including, 1931.

The most definite limitation to the growth of lespedezas in Ohio is a growing season long enough to mature seed. In the upper row of counties included in the area studied (viz., Licking, Muskingum, Guernsey, and Belmont) but few seedings have been made, and these have been only moderately successful. Seedings were reported from all the counties comprising the group to the south, Fairfield, Perry, Morgan, Noble, and Monroe. Only in southern Morgan County were natural seedings of lespedezas reported and only a few of these were reported as adding materially to the value of the pasture. Artificial seedings were reported to be from 30 per cent to 75 per cent successful and to be spreading slowly or not at all.[4] However, out of 30 seedings made in 1930 and 1931, only five were reported as producing a light crop of seed and only a few seeds were reported as maturing on each of nine others.

Several natural seedings were reported from Hocking, Vinton, Athens, and Washington Counties. Seedings were described as spreading, adding materially to, and even doubling the carrying capacity of some pastures. Artificial seedings were reported from 75 per cent to 100 per cent successful. Reports from 162 seedings indicated that 61 produced from a light to a heavy crop of seed, and a few seeds were produced on 29 others. Seedings in Hocking County were more successful than those in other counties.

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[2]Bimonthly Bulletin Vol. XIII, No. 2.

[3]Journal of the American Society of Agronomy Vol. XX, No. 2.

[4]Many of the cooperative seeding and fertilizer tests were made in 1930 and encountered unusually severe drouth conditions. Similar conditions early in the season were reported in 1931 for the seedings in Meigs and Gallia Counties. Unusually favorable rainfall was reported for the seedings in and near Athens County for the same season.

1 2 3 4

Japan lespedeza in southeastern Ohio pastures

1. But few seedings are being made. Some are moderately successful.
2. Natural seedings negligible. Seedings spread slowly, if at all. Seedings add materially to the value of but few pastures.
3. Natural seedings not unusual. Older seedings spreading slowly and adding materially to the value of some pastures.
4. Natural seedings predominate and are spreading more rapidly. A considerable portion of the pastures contain some lespedeza.

In the two tiers of counties in the southern part of the State, in which Pike, Jackson, Meigs, Adams, Scioto, Lawrence, and Gallia Counties are located, natural seedings predominate. Although there are large areas in these counties in which there is no lespedeza in the pastures, it was estimated by several co-operators who appear to be in position to know that in much of the area from 10

per cent to 50 per cent of the pastures contained some Japanese lespedeza. From 1 per cent to 20 per cent of the pastures in this area, it was estimated, were materially improved by the growth of the lespedeza. Reports from 95 seeding projects in Gallia, Lawrence, and Meigs Counties indicated fair to good seed production on 25 projects and a few seeds matured on 30 other projects. Fifty per cent of the co-operators reported volunteer seedings in their neighbors' pastures.

The following general conclusions from the results of the lespedeza tests to date seem justified: (1) As far as securing a stand is concerned there seems to be little difference between the Japanese and the Korean lespedeza, the difference being in favor of the Japanese. (2) Even in those counties where lespedeza thrives, only 30 per cent to 60 per cent of the seedings appears to be successful. (3) Chances for success with lespedeza seem equally good in any of the area studied south of, and including, Hocking and Washington Counties. (4) Chances for successful seedings in the counties to the north, including Perry and Licking, and those to the east were decidedly less favorable. (5) Since acclimated seed was used in these tests, the unsuccessful seedings apparently have been caused by late seedings, lack of a satisfactory seedbed, and competition from other plants, including wild or pasture grasses. (6) Although the percentage of successful seedings seems low, it may not be materially lower than it would have been for other legumes or grasses seeded under similar conditions. (7) In seeding lespedezas on pasture land, conditions should be made as favorable as possible and the seed sown in that part of the pasture apparently best adapted to it. (8) The practice of spot seeding small quantities of seed regularly each year is much better than sowing larger quantities of seed in any one year.

Which kind of lespedeza?—Two kinds of lespedeza have been grown in these experiments, Japanese lespedeza (*Lespedeza striata*) and Korean lespedeza (*Lespedeza stipulacea*), sometimes called Japan and Korean clover, respectively. Since the lespedezas are summer annuals, mature seed must be produced each year to furnish seed for a stand the following year.

Japanese lespedeza has demonstrated its ability to maintain itself under pasturing. The flat, creeping habit of growth, together with the fact that the seeds are borne in the axils of the leaves, makes killing out by pasturing difficult. While Japanese lespedeza is slightly later than the Korean, certain acclimated strains regu-

larly produce seed in southern Ohio. In this connection, it should be noted that seed produced in states adjacent to Ohio has proven preferable to that produced farther south.

Korean lespedeza is characterized by a wider leaf, a coarser, more upright growth, and a larger yield under favorable conditions. The seeds are bunched near the tips of the stems; consequently, the seed-bearing portions are grazed off in pasturing with the result that Korean lespedeza is inferior to the Japanese in this respect. The leaves of Korean lespedeza die at maturity whereas the leaves and stems of Japanese lespedeza tend to remain green until frost. Korean lespedeza is a more prolific seed producer than the Japanese. Korean lespedeza has been grown at Columbus since its first introduction in 1922 and has never failed to produce seed there.

Kobe and Tenn. 76 are larger, later growing strains of Japanese lespedeza and, though producing seed under favorable conditions, are too late to be of value in Ohio.

Lespedeza best in pastures.—Japanese lespedeza has a place in the permanent pastures of southeastern Ohio. It is at its best during the hot summer months when the grasses grow slowly. Lespedeza will grow on acid soils low in fertility, but it does better in soils of at least average fertility. The best pastures containing lespedeza, which the author has observed, have been either in fair blue-grass sod kept closely grazed or in pastures where there was but little competition from other grasses and weeds. It seems that some of the failures may have been caused by failure to pasture closely enough to give the lespedeza a chance, as the earlier growing wild grasses and weeds afforded too much competition. Lespedeza is often first seen along paths in the pasture where other vegetation will not grow. An occasional mowing of weeds and wild grasses in pastures favors both the Japanese lespedeza and the blue grass.

Other uses for lespedeza.—Lespedeza, more particularly the Korean, is used as a hay crop in the southern states. When sown either alone or with a companion crop, the growth in Ohio has not been sufficient to make the crop a competitor of either soybeans or Sudan grass for hay. Thatcher reports a test at Wooster in 1931 in which the growth was too small to make a satisfactory late cutting of hay. The maximum height of individual plants was one foot.

Willard reports that yields of forage have been taken on small areas only at Columbus but have indicated yields above 2 tons per acre from thick stands which were not over 14 inches high. The yields of the lespedezas are likely to be under-estimated in comparison with soybeans, red clover, and similar legumes.

Samples of first quality, Korean lespedeza hay at Columbus in two different years contained only 13.2 per cent of crude protein; whereas Japanese on an adjacent plot one year contained still less. Evidently, the lespedezas are generally lower in protein than the more common legumes in the State.

The root system of the lespedezas is that of a typical annual plant, comparatively shallow and very limited in amount. In tests at Columbus and at the Southeastern Experiment Farm in early September, the roots of Korean amounted to only 11.5 per cent of the total weight of tops and roots and contained only 1.38 per cent of nitrogen.

Selection of seeds.—The selection of seed is an important factor in securing a permanent stand of lespedeza. Seedings made from seed from different out-of-state sources showed considerable variation in bloom with a spread of several weeks in the date of first bloom. In previous tests, plants from Louisiana seed failed to produce mature seed in Ohio.

Lespedeza seed does not retain its vitality as long as the seed of some other legumes. Several germination tests made in the spring of 1931 showed samples of seed purchased on the market varying from 80 per cent to 90 per cent. Seed but a few years old tested materially below 50 per cent. Hard seeds in the samples ranged from none to 11 per cent. The hard seed may remain in the soil for one or more years before germinating and thus enable a seeding to survive a season of unfavorable conditions.

The purchase of lespedeza seed affords an excellent opportunity for the introduction of certain weed seeds. Of these, dodder is the most to be feared. Apparently, most lots of seed on the open market contain some dodder. The weed has not been troublesome in open pastures, but on cultivated land it has been a serious pest. Once dodder has been introduced, burning over the area seems the only practical method of combatting it. A few growers advertize dodder-free seed.

Time of seeding.—Late seedings are sometimes the cause of failure to get a stand. When seed is sown in the open pasture, freezing and thawing or heavy rains are necessary to cover the seed properly. In the spring of 1931, heavy rains the last of April on the Southeastern Experiment Farm were favorable to late seedings and little difference was apparent between the earliest and the latest seeded plots. While some growers insist that seedings should be made as early as January, February seedings are probably equally as good and the first of March seems fully as late as seedings can be made with safety, with normal climatic conditions.

Special preparation of the seedbed when lespedeza is seeded in a light blue-grass pasture sod does not seem to be necessary. In several tests, discing a fair sod before seeding did not result in a better stand or a more permanent seeding. However, a thick mat of poverty grass or broom sedge might well be broken up by burning or discing or both before seeding. Some failures were apparently caused by too heavy a mat of these or other wild grasses.

How much to sow.—As the seed is usually rather expensive, the seeding of about 4 pounds of seed per acre on pasture land is the more common practice in Ohio. If the seedings do well, the second or third year should result in a much improved stand. A practice found desirable by many, especially where conditions are not altogether favorable, is that of sowing a relatively small quantity of seed regularly for a series of years, rather than making a heavy seeding any one year.

Need for fertilizer and limestone.—Lespedeza will thrive on this soil where there is but little competition from other vegetation. In a series of fertility pasture plots on the Washington County Experiment Farm, Japanese lespedeza added materially to the production of the unfertilized plots. The lespedeza also did well on those plots receiving a light application of fertilizer, but where conditions were made most favorable to blue grass, the lespedeza made but little headway. Other experiments with fertilizer verify the conclusion that while on poor soil lespedeza responds markedly to light applications of fertilizers, it does not seem able to use heavy applications advantageously. A limited number of tests with limestone indicate no great advantage from its use. The tests in progress should answer this question rather definitely,

THE COST OF GROWING, HARVESTING, AND STORING APPLES

F. H. BALLOU

In 1929 a report was made of a 5-year (1924-1928, inclusive) cost account of production of apples at the Dale View Test Orchards in central Ohio. Although it is purposed to issue another bulletin at the close of the second 5-year period (1929-1933, inclusive) dealing with the same subject and containing subsequent data from the same orchards (in which there has been no interruption of continuity of the work), a much condensed report of the progress of the project up to the close of the eighth season's cost accounting may be of sufficient interest to justify publication at this time.

First in interest, perhaps, is the fact that the actual average cost per bushel per year for production (expenditures for labor and materials devoted wholly to growing the apples) amounts to but little more than one-half the average cost per bushel per year of harvesting and preparing the fruit for market or storage—these costs averaging 22 and 41.3 cents per bushel, respectively (Table 1).

Second, it is scarcely less interesting to note that during the same period of years the average expenditure per bushel for production was only two-thirds that of the combined transportation and storage costs, the comparison being 22 cents as against 33 cents, respectively.

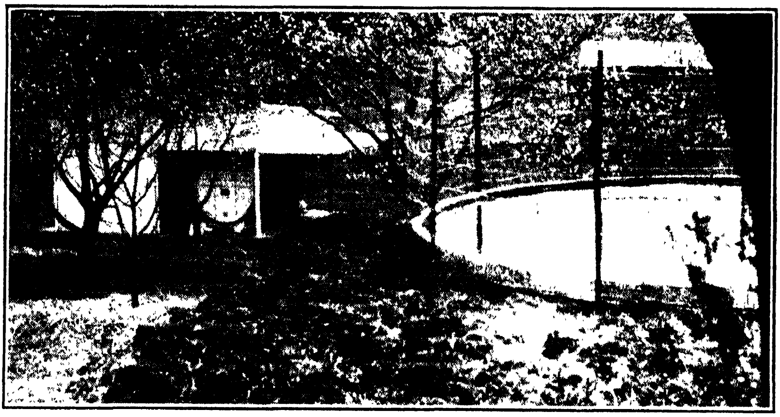

Fig. 1.—Water storage cistern and stationary spray plant used in the Dale View Test Orchards.

Other items of cost are: interest on investment in orchard machinery and equipment, repairs on orchard equipment and depreciation in value of same, interest on investment in orchard land, and taxes on land and equipment. These items, in this central Ohio project, during the 8-year period just closed, amounted to an average cost of 13.7 cents per bushel per year.

Considering these various costs of growing, handling, and storing apples for market, it will be noted that the fruit must sell at a price beyond five times the actual cost of production in the orchard, if the grower is to realize even a small margin of profit per bushel. All details of this enterprise were cared for by hired labor and paid for in cash.

TABLE 1.—Cost per Bushel of Growing and Handling 23,600 Bushels of Apples for the 8 years—1924 to 1931, Inclusive—The Dale View Test Orchards, Licking County

Items of cost	1924	1925	1926	1927	1928	1929	1930	1931	Average per year for 8-yr. period
Production: Pruning and clearing out brush; fertilizers and their application; spraying materials and spraying; gasoline and oil; mowing orchards twice each season; thinning the fruit in seasons of over-heavy setting	17.8	16.1	18.1	14.4	30.7	41.7	24.4	13.3	22.0
Harvest and preparation of the fruit for market: Picking; hauling the apples to the packing-house; sorting, sizing, and packing; cost of container complete	43.2	38.0	39.2	44.7	42.8	45.7	41.4	35.4	41.3
Transportation to storage and storage costs	29.0	31.0	33.0	29.0	36.0	44.0	41.0	27.0	33.7
Overhead: Interest on investment in orchard machinery and equipment; repairs and depreciation in value of machinery and equipment; interest on assessed value of orchard land plus taxes on land and equipment	7.5	5.9	4.9	9.0	16.9	22.8	25.4	17.4	13.7
Total cost of apples, per bushel per year, for the 8-year period, for production, harvesting, preparing for market or storage, storage costs, and overhead expenses	$0.97+	$0.91	$0.95+	$0.97+	$1.26+	$1.54+	$1.32+	$0.93+	$1.10+

Fortunately, no crop failures occurred in this orchard during the 8-year period covered by the data presented here. Had partial or serious loss of fruit in one or more seasons materially reduced the average yield per year, the cost per bushel of apples obviously would have been considerably increased.

Those who study carefully the accompanying cost account table will note occurrence of recent increases in cost of production of apples and overhead expenses of the orchard enterprise. These marked increases, beginning in 1928 and conspicuous in the 2 succeeding years, were due: First, to somewhat smaller production, in bushels, in 1928-1929-1930; second, to installation of new and expensive machinery and equipment; third, to more extensive employment of thinning apples wherever over-abundant setting of fruit occurred; and fourth, to introduction of insurance against losses by hail.

The accompanying cost account data, obtained solely at the Dale View Orchard project situated in the hilly section of central Ohio, are probably fairly representative of average costs of apple production, handling, and storage under similar conditions prevailing in various other upland or semi-mountainous areas of our own State and adjoining states.

THE LATE COBBLER, A NEW VARIETY OF POTATO

JOHN BUSHNELL

The Late Cobbler is a new potato, very similar to the Irish Cobbler in type of vine and type of tuber, except that it matures about 2 weeks later. According to the originator, F. S. Hollenbeck, of Tully, N. Y., it is a selection from the Irish Cobbler.

It has been tested for four seasons at Wooster in comparisons with the Irish Cobbler and the Russet Rural. The tests were started early (that is, in late April) at the time Irish Cobblers are usually planted. The approximate dates of maturity were:

Irish Cobbler	August 15
Late Cobbler	September 1
Russet Rural	September 20

In unfavorable seasons, the Irish Cobbler yields very poorly on the ordinary soils of northeastern Ohio; hence, it has not become popular in this district. The Late Cobbler has endured unfavor-

able weather at Wooster much better. In average yield, it has almost equalled the Russet Rural planted at the same date (Table 1).

TABLE 1.—Comparisons of Late Cobbler with Irish Cobbler and Russet Rural

Yield in bushels per acre, at Wooster

	1928	1929	1930	1931	Average
Irish Cobbler	273	146	68	143	158
Late Cobbler	286	184	144	188	201
Russet Rural	290	194	149	242	219

The tuber shape is very similar to the Irish Cobbler. In the test plots it has never produced secondary growths, such as are common on early-planted Russet Rurals which encounter unfavorable weather in midsumer. The illustration shows the typical tubers as grown at Wooster in 1931. It may be noted that several tubers of the Russet Rural in this photograph have a constriction, giving the undesirable dumbbell shape. None of the Cobblers had this shape. On the other hand, the undesirable deep eyes and irregularities of surface which characterize the Irish Cobbler are present in the Late Cobbler. Moreover, in the opinion of the writer it has the same excellent cooking quality as the Irish Cobbler.

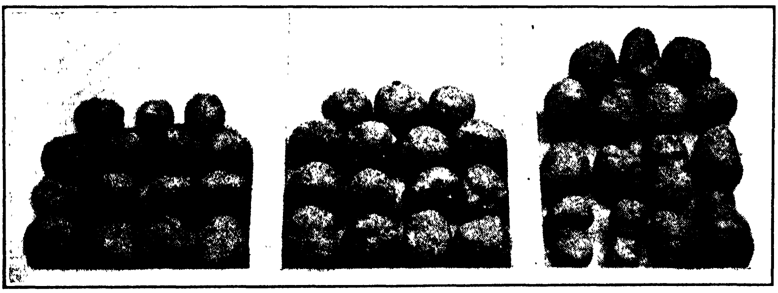

Fig. 1.

Irish Cobbler **Late Cobbler** **Russet Rural**

Typical tubers from plots at Wooster, planted April 25, 1931.

The new variety is recommended for trial in northern Ohio wherever a variety earlier than the Russet Rural is needed and, particularly, where the Irish Cobbler has not proved successful. It may also be of special value to growers who wish to spread harvesting operations over a long period and are seeking a variety inter-

mediate in maturity between the Irish Cobbler and the Russet Rural. It will probably not supersede either of the older varieties but will supplement our variety list.

In southern Ohio, where the Irish Cobbler is the standard variety, the Late Cobbler has not yet been tested. However, in this district earliness is a distinct advantage in potatoes, and, thus, the Late Cobbler is not likely to encroach upon the popularity of the earlier Irish Cobbler.

A small quantity of certified seed of the Late Cobbler was grown in New York in 1931 for commercial trade. The Experiment Station has none for sale or for distribution.

THE FARM FAMILY'S FOOD

HUGHINA McKAY

Studies made of the foods used by rural families in Ohio during 1926, 1927, and 1928 indicate that, in terms of money value, the food produced on the farm and used in the home represented from 55 to 60 per cent of the total money value of all food used in the home during that period. Studies made in Vermont and in Minnesota indicate that a somewhat smaller proportion of the total money value of foods used in the home was represented by farm-produced foods; whereas in Mississippi and in Nebraska a somewhat larger proportion of the money value of the foods used in the home was so represented.

Computations to determine the nutritive value of the foods used during each of the 3 years in Ohio showed that the year in which the money value of the food produced on the farm and used in the home was largest was also the year when the nutritive value of the diet was highest.

This is of interest in connection with the present situation in Ohio. Crops have been abundant. There has been an exceptionally large yield of vegetables and fruits. It is said that the rural home has seldom had such stores of fruits and vegetables in cellar and store room as during this year. This undoubtedly means the use of fruits and vegetables in the diet in generous amounts. With the interest in the use of wheat products and, therefore, with an

increased use of farm-produced cereal products, there will, without doubt, be a larger proportion of farm-produced foods used in the farm home.

Practically all the milk and cream used in the farm home are produced on the farm. With suitable amounts of cereal products, milk, and fruits and vegetables, the farm home can be assured of an adequate diet.

The liberal use of fruits and vegetables is very desirable. Minerals, vitamins, and organic acids, provided by this group of foods, are of value in the diet. Fruits and vegetables supplement the cereal and milk diet at the points where it most needs supplementing. As shown by the study of foods used in Ohio farm homes during the 3-year period, the use of fruits and vegetables, as indicated by the percentage of total calories provided by this class of foods, was considerably less than the amount considered advisable for good nutrition. The increased use is therefore desirable.

Practically all dietary studies made of rural families have shown the iron content of the diet more frequently deficient than any other dietary factor considered.

The most recent analysis of foods, in relation to the iron content, was made by Peterson and Elvehjem, of Wisconsin, who determined the iron content of about 150 samples of common foods and showed that, when calculations were made on the basis of undried edible portions and the foods were listed in descending order with reference to iron content, the classes of foods ranked as follows: dried legumes, green leafy vegetables, dried fruits, roots and tubers, non-leafy vegetables, fish, and fruits.

Such foods as legumes contain little moisture. When the calculations were made on the dry basis, the green leafy vegetables were found to contain more than six times as much iron as legumes. The conclusion is drawn, therefore, that green leafy vegetables are the best sources of iron in the diet. Such figures indicate how the needful iron may be provided in the diet of rural families.

It has been known for some time that copper is necessary for the utilization of iron in hemoglobin formation. Foods analyzed for iron by Wisconsin workers were also analyzed for copper. Copper in varying amounts was found in all foods examined; consequently, although little is known regarding the amount needed in the diet, it seems probable that copper is adequately provided when foods are used in their natural state.

Remington, Director of the South Carolina Food Research Commission, reports that, in a series of observations of the hemoglobin values and red cell count of 75 normal young women and 28 young men, it was found that those having the higher hemoglobin values and cell count were found to be using larger quantities of vegetables and fruits than those who had the lower hemoglobin values and cell count.

Sheets et al. report a greatly increased hemoglobin formation in experimental animals when mustard greens, turnip greens, and collards were fed to the animals in addition to the basal diet used.

Recent work with vitamins indicates that they are even more important as factors in health than had been thought previously. Vitamins must be provided in liberal amounts if health and vigor are to be maintained.

Vitamin C is probably frequently found in too small amounts in the rural diet. This need not be the case when fruits and vegetables are produced in the abundance of this year. Tomatoes, either fresh or canned, are excellent sources of vitamin C. Tomato juice is an effective anti-scorbutic and may be used even for infants and young children. Raw cabbage is equal to tomato in anti-scorbutic value. When cooked, cabbage loses a much larger proportion of vitamin C than aoes the tomato. Potatoes may be considered important in provision of vitamin C, because, although their vitamin-C content is less than that of cabbage, they are used in large amounts.

Other vegetables contribute vitamin C to the diet, but the tomato, cabbage, and potato are outstanding examples of commonly used vegetables which are serviceable as sources of this vitamin and of which there is a plentiful supply this year.

Fruits also are useful in providing vitamin C. Strawberries have been shown to be as rich as the tomato in this vitamin. Raspberries, currants, and gooseberries are also good sources of vitamin C. Apples are eaten raw so extensively that they may be considered fairly good sources of vitamin C, although they contain less of the vitamin than do some of the other fruits.

Every year brings fresh proof from food research laboratories of the relation of food to health. The value of milk, fruits, and vegetables in the diet has been demonstrated. A liberal use of these products in the rural home is desirable.

FORECLOSURES ON FARM REAL ESTATE IN PUTNAM, UNION, AND GREENE COUNTIES, OHIO, 1910-1931

V. R. WERTZ

The number of foreclosures on farm real estate gives some indication of the farm mortgage situation. The number of foreclosures on farm real estate in Putnam, Union, and Greene Counties, Ohio, increased from an average of four from 1910 to 1914 to 77 in 1931. In the same period, the number of acres foreclosed on increased from an average of 341 to 9,199 acres in 1931.

TABLE 1.—Foreclosures on Farm Real Estate in Putnam, Union, and Greene Counties, Ohio, 1910-1931

Year	Foreclosures	Amt. of land	Judgment against property	Amount for which property sold	Difference between judgment and sales
	No.	*Acres*	*Dol.*	*Dol.*	*Dol.*
Average 1910-1914	4	341	13,688	21,013	+ 7,325
Average 1915-1919	5	281	15,666	21,985	+ 6,319
Average 1920-1924	14	1,451	97,972	102,677	+ 4,705
1925	30	3,280	249,569	210,836	− 38,733
1926	29	2,782	186,289	157,153	28,136
1927	33	3,918	208,133	195,471	− 12,662
1928	45	5,420	380,197	287,441	− 92,756
1929	46	4,321	281,588	221,668	− 59,920
Average 1925-1929	37	3,944	261,155	214,514	− 46,441
1930	43	4,814	234,079	177,875	− 56,204
1931	77	9,199	575,310	402,617	−172,693

From 1910 to 1914 the annual average judgment against the farms foreclosed on amounted to $13,688 and the amount for which the land sold averaged $21,013; that is, the property sold for 54 per cent more on the average than the judgment against it. By 1931 the judgment had increased to $575,310, and the amount for which the property sold amounted to $402,617. In other words, the property sold for 30 per cent less than the judgment allowed against it by the court in 1931.

On the average, the property in these three counties sold for more than the judgment against it until 1925. Since 1925 the property on which foreclosure proceedings were taken sold for less than the judgment by quite a large margin.

These figures show only a part of the forced sales in these counties, for not all forced sales went through the courts. There has been in the last few years an increase in the number of voluntary transfers of farm real estate to those holding mortgages against it. In 1925, 15 farms were voluntarily transferred to

financial institutions, such as insurance companies, banks, building and loan companies, etc., in lieu of payment on mortgages. This merely amounts to foreclosure without the legal procedure. In 1925 the number of acres thus transferred to financial institutions amounted to 1,867 and in 1931 it had increased to 4,065. In addition, there were also transfers of farms to individuals in payment of mortgage debt, but the number of such transfers could not be gotten from the county records.

TABLE 2.—Farms in Putnam, Union, and Greene Counties Voluntarily Assigned to Financial Institutions, 1925 to 1931

	Farms	Land
	No.	*Acres*
1925	15	1,867
1926	19	1,695
1927	14	2,296
1928	21	3,019
1929	35	3,350
1930	33	3,746
1931	36	4,065

PRICES OF OHIO FARM PRODUCTS, 1880 TO 1931

J. I. FALCONER

Many are now comparing the present prices of farm products with those of the nineties. The Ohio Agricultural Experiment Station has compiled a series of index numbers showing the prices of Ohio farm products from 1865 to date. If the prices for the years 1910 to 1914 are taken as 100, the prices received in 1896 would have been 55 while those of the year 1931 would have been 93, or those of December, 1931, an index of 73. Thus, it would appear that the prices of Ohio farm products in 1896 were 25 per cent below those of December, 1931. The index number of wholesale prices of all commodities, as constructed by Warren and Pearson, was 31 per cent lower in 1896 than in December of 1931.

TABLE 1.—The Prices of Ohio Farm Products, 1880 to 1931
1910-1914=100

Year	Price index	Year	Price index	Year	Price index	Year	Price index	Year	Price index	Year	Price index
1880....	93	1890...	77	1900.	71	1910...	99	1920..	242	1930..	130
1881....	100	1891...	74	1901...	72	1911.	90	1921...	136	1931...	93
1882....	87	1892...	74	1902..	79	1912...	106	1922...	136	Dec.	
1883....	84	1893...	76	1903..	76	1913...	100	1923..	149	1931	73
1884....	74	1894...	66	1904..	75	1914..	107	1924...	150		
1885....	68	1895...	64	1905..	79	1915..	110	1925...	164		
1886....	72	1896..	55	1906..	82	1916...	121	1926..	176		
1887....	81	1897...	58	1907...	90	1917...	198	1927...	163		
1888....	71	1898...	63	1908...	90	1918..	243	1928..	147		
1889....	67	1899...	64	1909...	98	1919...	266	1929...	161		

Although the above statement holds true for farm products as a whole, the price position of different products varies. If we compare December prices of 1931 with those of the low December prices of the nineties, we shall find that in 1894 Ohio wheat was worth 48.9 cents per bushel whereas in 1931 it was 44.3 cents. Corn was quoted at 21.3 cents in December of 1896 and at 31 cents in December 1931, oats at 18.7 cents per bushel in 1896 and at 23.1 cents in 1931. Hogs were $2.75 per hundred in December of 1896 and $4.00 in 1931. Beef was $3.30 per hundred in 1894 and $5.20 in 1931. Butter was 9 cents per pound in 1896 as compared with 28 cents in 1931. Wool was 15 cents per pound as compared with 17 cents in 1931. Thus, it would appear that while the price level of Ohio farm products is still considerably above that of the low nineties, particular products are now lower than they were in the nineties.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

During December and January the gain in prices of Ohio farm products made in November was more than lost. In December a new low level of prices was reached. For the year 1931, Ohio farm product prices averaged over 28 per cent below those of 1930. Likewise, the income to Ohio farmers from the sale of farm products for the year was about 28 per cent less than in 1930. The low volume of business on many farms during the first half of the year, because of the lack of feed resulting from the drouth of 1929, tended to keep down the income. In this respect, the year 1932 is being started under much better circumstances since 1931 yields were generally good. The prices of products which farmers buy, with few exceptions, continue their decline. Industrial employment in November was 65 per cent of that in 1926 while the pay roll total was 51 per cent that of 1926.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	143	232	156	139	169	96	154	147
1929	141	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	129	130
1931	......	......	......	80	120	82	91	93
1930								
January	136	234	153	134	158	......	141	159
February	135	231	152	131	......	......	136	114
March	133	235	151	126	......	90	132	131
April	132	231	151	127	158	......	136	135
May	130	228	150	124	......	......	132	128
June	127	227	149	123	......	......	131	138
July	123	224	148	111	155	......	123	134
August	123	224	147	108	......	......	125	116
September	123	227	146	111	......	......	129	126
October	121	220	144	106	147	......	125	133
November	117	215	142	103	......	......	122	124
December	114	216	139	97	......	......	112	119
1931								
January	112	212	137	94	133	......	115	115
February	110	215	136	90	......	......	98	85
March	109	219	134	91	......	82	100	104
April	107	215	133	91	119	......	103	97
May	104	211	130	86	......	......	98	90
June	102	207	129	80	......	......	93	93
July	102	207	128	79	115	......	86	86
August	102	207	127	75	......	......	87	90
September	101	205	124	72	......	......	83	87
October	100	199	123	68	116	......	77	86
November	100	196	123	71	......	......	81	93
December	......	......	......	66	......	......	73	88

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 494. Life History and Composition of the Soybean Plant, by H. L. Borst and L. E. Thatcher. Data are presented on the influence of rate and date of planting on growth and composition of the soybean plant, on the best date of cutting for hay, and on the yield and composition of soybeans at various stages of maturity.

Bulletin 495. Variations in Livestock Production Costs and Returns in Putnam County, by John F. Dowler. This bulletin reports an economic study of the cost factors and their relative amounts in hog, cattle, sheep, and poultry production in Putnam County. A comparison of cost and returns on livestock is given.

Bulletin 496. The Causes and Control of Damping-off of Tomato Seedlings, by L. J. Alexander, H. C. Young, and C. M. Kiger. The economic importance and description of diseases, the pathogens, experimental procedure, and methods of control of damping-off of tomato seedlings are discussed, with a supplementary consideration of damping-off of other than tomato seedlings.

Bulletin 497. The Fiftieth Annual Report. A report of representative experiments from each of the departments and the District and County Farms is given, together with a general report of Station activities, new projects, publications, and finances. The agronomic experiments reported include tests on fertilizers, liming, corn varieties, drill comparisons, wheat clipping and quality, oats varieties, hays, pastures, lawns, soil, and the Ohio soil survey. Various controls, both sprays and dusts, are considered for prevention and control of diseases and insect pests of fruits, flowers, weeds, vegetables, and trees. Horticultural experiments on fertilizers and various technical phases of production of potatoes, vegetables, apples, pears, peaches, small fruits, and flowers are discussed. Animal work reported includes numerous tests of feeds for all animals and for milk production in cattle, nutrition experiments, poultry experiments, disease control, and vitamin studies. Studies of foods, child growth, silks, and dyes are reported. Economic studies of milk marketing, yield of hogs, marketing tomatoes, mortgage and tax problems, and farm population are discussed. Engineering developments include power-requirement studies, combine investigations, plow draft tests, corn storage tests, and drainage studies. Forestry work in state forests and parks, forest planting, fire control, tax law, growth of pine species, and utilization of waste land is presented. Weather data are given for the year.

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[1]In cooperation with College of Agriculture, Ohio State University.
[2]In cooperation with the U. S. Department of Agriculture.

The Bimonthly Bulletin

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Ohio Agricultural Experiment Station

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

Forestry Plantation, Wooster, Ohio

IMPROVED PLACEMENT OF FERTILIZERS IN THE HILL FOR CORN[1]

A progress report of investigations involving both controlled hand placement experiments and field performance tests of commercial corn planter fertilizer attachments

R. M. SALTER, C. O. REED, E. E. BARNES, AND C. L. THRASH

A recent survey indicates that 90 per cent of the farmers who fertilize corn in Ohio put a part, or all, of the fertilizer in the hill or row. Field experiments conducted during the past 5 years at 12 scattered locations in the State have demonstrated that such localized applications are generally more efficient than broadcast applications. In the hands of farmers, however, hill or row placement has not been uniformly successful. Germination injury has frequently been reported, especially when dry weather has followed planting or where heavy rates of application have been employed. The use of planter fertilizer attachments giving too little separation of seed and fertilizer is believed responsible for much of this trouble.

Since 1929, agronomists and agricultural engineers of the Station have been cooperating in experiments designed to determine: (1) the comparative safety and efficiency of different horizontal patterns and different depths of fertilizer in the hill as obtained by accurately controlled hand placement and (2) the comparative performance of commercial corn planter fertilizer attachments with increasing rates of application in the hill. Results obtained in the hand placement studies have served to bring out the principles involved and to indicate what types of placement are preferable. The tests of commercial machines have made it possible to evaluate different designs, in terms of performance, regarding both safety and efficiency. The manufacturers have been kept informed as to the findings, with the result that several have greatly improved the design of their distributors. Several of these improved machines are now on the market.

The purpose of the present report is to present the more salient features of the investigations to date. The principles which appear to underlie hill placement will be emphasized and also some of the features of design in commercial machines that make for satisfactory performance. A knowledge of the latter should aid the

[1]Contribution from the Departments of Agronomy and Agricultural Engineering.

farmer in discriminating among the various makes now on the market. It should be pointed out that certain questions with regard to hill placement are as yet unsettled and that perhaps perfection cannot be claimed for any of the commercial machines so far developed. The investigations are being continued, and a more complete report may be expected later.

HAND PLACEMENT EXPERIMENTS

In both 1930 and 1931, hand placement experiments were conducted on Wooster silt loam at Wooster and on Miami silty clay loam at Columbus. Fifteen different placements involving different patterns and depths were compared each year. The plan was identical for the two locations in a single year but varied slightly in the 2 years. In all cases, each placement was represented by four distributed, 12-hill, single row plots for each rate and kind of fertilizer included. Unfertilized check plots were interspersed at frequent intervals. A standard 4-12-4 fertilizer, compounded of sulfate of ammonia, 20 per cent superphosphate, and muriate of

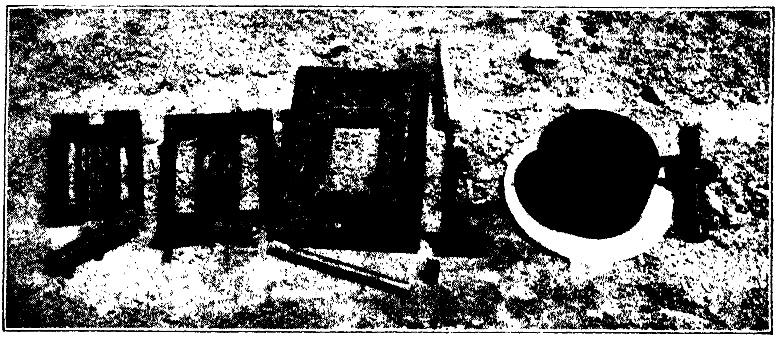


Fig. 1.—Devices used in distributing fertilizer in hand placement experiments on corn

potash, was used at two rates; i. e., 200 and 400 pounds per acre. A fertilizer of the same ratio, compounded of ammonium phosphates, ammonium sulfate, and muriate of potash, and approximately three times as concentrated was used at rates to carry nutrients equivalent to 200 and 400 pounds of 4-12-4. The fertilizer was applied and the corn planted by hand. The work was facilitated by the use of several specially designed devices shown in Figure 1. The hills were spaced 42 inches each way and planted at the rate of four kernels per hill. Carefully graded seed of high germination was used.

The agronomic data obtained included stand at intervals during the period of emergence, final stand, height to the end of the longest leaf approximately 6 weeks after planting, days from planting to mean silking date, yield and moisture content of grain, and yield of stover. The usual daily weather records were taken throughout the season. The daily rainfall for May and June of each year is shown in Table 1.

TABLE 1.—Record of Daily Rainfall During May and June in 1929, 1930, and 1931 at Wooster and in 1930 and 1931 at Columbus

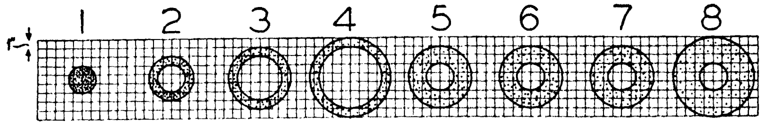
Date	Rainfall in 1929		Rainfall in 1930				Rainfall in 1931			
	Wooster		Wooster		Columbus		Wooster		Columbus	
	May	June	May	June	May	June	May	June	May	June
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
1										.34
2	.41						.11			
3	.20									
4	.02							.37	.05	
5	.60							.05		.79
6	.01		.17	.13	.08		.01	.17		
7	.04		.03				.10	1.18	.26	
8		.19					.45		.32	.60
9									*	
10							.07			
11				.02			.05		.27	
12	.35	.03	.06		.08		.40			
13	.02						.46		.33	
14	.58	.23	.37		.06 *			.22	.24	
15	1.00		.04					.14		.15
16	.01			.80	.06	.25		.02		.12
17				.12		.44	1.03		.75	
18			.36	.20		.71				
19	.93	1.53	.35		.40		.10			
20		.40			.31		.26 †		.37	
21	.45			.03					.14	
22							.22	.02		
23		.58	*			.15	.22	.01		.65
24	.11		.11 †	.88	.12				.31	
25		.28					.22			
26				.43			*	.41	.27	
27					.01	.03		.57		
28	.11 †	.59	.10		.06					
29								.33		.49
30		.26		.25		.02	.48			
31							.27			
Total	4.84	4.10	1.59	2.86	1.18	1.60	4.45	3.49	3.31	3.14
Normal	3.86	4.00	3.86	4.00	3.55	3.38	3.86	4.00	3.55	3.38
Deviation from normal	+.98	+.10	−2.27	−1.14	−2.37	−1.78	+.59	−.51	−.24	−.24

*Planting period, hand placement test.
†Planting period, corn planter test.

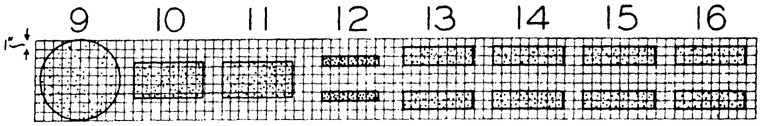
The entire season of 1930 was extremely dry at both locations. Damage to germination from unfavorable placements was severe, especially at Columbus where the rainfall was even less than at Wooster. Considerable response to fertilizers was shown in the early height measurements, but the continued drouth resulted in very low final yields, small increases for fertilizer, and a high proportion of barren stalks. The season of 1931 at Wooster was quite

DIAGRAM OF FERTILIZER PLACEMENTS USED

SEED PLANTED AT A DEPTH OF 1.5 INCHES AND
WITHIN A CIRCLE OF 1.5 INCHES DIAMETER



YEAR	BOTH	BOTH	BOTH	BOTH	BOTH	1930	1930	BOTH
DEPTH - IN.	0.75	0.75	0.75	0.75	0.75	SURFACE	1.5	0.75
AREA - SQ IN	7.1	12.5	19.0	25.0	31.5	31.5	31.5	56.5



YEAR	BOTH	BOTH	BOTH	BOTH	BOTH	1931	1931	1931
DEPTH - IN.	0.75	0.75	MIXED TO 1.5	0.75	0.75	SURFACE	1.5	2.5
AREA - SQ. IN.	63.6	31.5	31.5	12.5	31.5	31.5	31.5	31.5

Fig. 2

favorable throughout, also at Columbus except for a period of hot, dry weather in July. The Columbus planting suffered a heavy infestation of smut; whereas that at Wooster lodged badly as the result of a wind storm. Both factors tended to make the final yields somewhat erratic, an effect that was further augmented by inter-row competition, especially evident where a favorable placement adjoined one that caused considerable reduction in stand. As a whole, it is believed that the safety of the various treatments was accurately indicated by the stand data. The relative efficiency of the treatments was probably well measured by the increases in early height. The value of height measurements in this connection is supported by the fact that, in large-plot fertilizer tests covering several years under conditions where difference in stand and inter-plot competition have been slight, early height regularly has been found closely correlated with final yield

(Rxy = approx. 0.85. p. = .01—).

Although it is regrettable that the yield data for the hand placement work are somewhat unsatisfactory, this fact does not seriously affect the interpretation of the data as a whole.

The more important placements employed in both years are shown diagrammatically in Figure 2. The final stands, stated as per cent of the average of all checks, and the increases in early height, figured progressively from the nearest checks and stated in inches, are shown for selected treatments in Table 2. Since there appeared to be little difference in the results obtained with the standard and concentrated fertilizers used in equivalent amounts,

the data shown are averages for both fertilizers. Thus, each single-year figure for a given placement at one location represents the mean of eight individual plots; whereas the final averages for both locations and both years include 32 individual-plot records with a few exceptions as noted. The table also includes final averages for increase in yield of grain, calculated progressively from the nearest checks and reduced to a 15½ per cent moisture basis. As previously noted, these data are subject to considerable question and cannot be employed for drawing fine distinctions between placements.

ANALYSIS OF RESULTS OF HAND PLACEMENT STUDIES

Accuracy.—Some idea of the significance of variations in the data of Table 2 is gained from probable errors calculated for the check plots. The average probable errors for the mean of eight check plots for a single year at a single location are as follows: (1) stand, 1.18 per cent; height, 0.63 inches; yield, 1.58 bushels. Similarly, the probable errors of the combined means of eight check plots for both years and for both locations are as follows: (1) stand, 0.38 per cent; height, 0.27 inches; yield, 0.85 bushels.

Horizontal separation of seed and fertilizer.—Placing the fertilizer in a circle of 3-inch diameter ¾ inch above the seed (placement No. 1) has seriously reduced stand, height, and yield at both rates of application. When placed in a circular band 1 inch wide, an internal diameter of 3 inches (minimum separation of seed and fertilizer, ¾ inch) has been both safe and efficient at the 200-pound rate with no appreciable advantage for greater separation: For the 400-pound rate the minimum safe internal diameter is 5 inches.

Width of fertilizer band.—At the 200-pound rate with both circular and parallel lateral bands, there appears a slight, although doubtfully significant, gain in efficiency from increasing the width of the fertilizer band to more than 1 inch. At the 400-pound rate, bands 2 inches and 3 inches wide are superior both in safety and efficiency. It should be noted that the yield increases for placements Nos. 2 and 5 are probably too high resulting from their location adjacent to, and on either side of, placement No. 1 which produced severe reduction in stand.

Depth of fertilizer band.—With the 2-inch-wide circular and lateral bands employed, stands were not appreciably affected by varying the depth, although the reduction indicated for the 400-pound rate at seed level (1½-inch depth) in 1930 at Columbus is probably significant. Surface applications appear relatively in-

TABLE 2.—Effect of Fertilizer Placement on Stand, Early Height, and Yield of Corn

Wooster and Columbus, 1930 and 1931

Placement No.	Final stand as per cent of check average										Height increase over checks approx. 6 weeks after planting										Yield—Av. increase over check 15½% moisture	
	200 lb. 4-12-4 per acre					400 lb. 4-12-4 per acre					200 lb. 4-12-4 per acre					400 lb. 4-12-4 per acre						
	Wooster		Columbus		Av.	Wooster		Columbus		Av.	Wooster		Columbus		Av.	Wooster		Columbus		Av.		
	1930	1931	1930	1931		1930	1931	1930	1931		1930	1931	1930	1931		1930	1931	1930	1931		200 lb.	400 lb.
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	Bu.	Bu.
Fertilizer placed at varying horizontal distance from the seed																						
1	63	60	9	63	48.5	25	25	0	29	20.0	8.0	—7.9	—2.0	2.0	0.1	1.9	—13.3	0.0	—4.5	—4.0	—12.4	—28.3
2	101	97	91	91	94.8	95	68	55	80	74.2	14.0	5.6	6.2	10.8	8.9	8.3	1.5	2.2	7.2	4.8	7.3	0.5
3	102	101	99	93	97.7	98	103	99	95	97.8	15.1	6.0	5.7	10.9	9.4	11.7	6.1	8.2	12.5	9.6	1.4	4.0
4	96	101	99	94	97.7	102	100	100	95	98.3	13.8	5.4	5.3	8.7	8.3	12.9	7.4	8.2	10.5	9.7	8.1	1.4
Increasing width of fertilizer band																						
2	101	97	94	91	94.8	95	63	55	80	74.2	14.0	5.6	6.2	10.8	8.9	8.3	1.5	2.2	7.2	4.8	7.3	0.5
5	101	101	97	92	96.4	99	92	89	91	91.9	16.8	6.1	5.7	11.5	9.9	14.2	3.8	5.8	10.6	8.6	9.1	8.8
8	100	100	102	96	98.1	98	101	100	94	97.1	18.1	5.5	6.1	10.2	10.0	17.9	6.3	6.8	12.0	10.7	3.5	3.2
9	94	103	95	93	95.1	95	86	68	93	84.8	19.2	5.7	5.9	10.9	10.5	18.0	3.6	4.0	10.7	9.1	3.4	—0.2
12	101	100	99	95	97.6	101	94	95	91	94.5	11.1	6.2	6.3	12.0	8.7	13.9	5.2	5.1	11.5	8.1	2.5	—0.3
13	100	100	101	96	97.7	93	103	100	95	97.3	13.0	6.9	7.0	10.1	9.4	11.9	6.3	5.3	12.2	8.7	4.7	3.6
Varying depths of placement employing circular or parallel lateral 2-inch bands																						
6-14	101	104	98	95	98.0	100	101	97	93	96.9	6.6	5.6	2.9	7.7	5.7	9.6	7.9	4.0	12.0	8.4	2.1	2.8
5-13	101	100	97	95	96.9	99	103	89	95	95.6	16.8	6.1	5.7	10.1	9.7	14.2	6.3	5.8	12.2	9.6	6.6	5.3
7-15	101	100	95	94	96.8	97	100	80	95	92.2	15.5	7.0	7.1	11.1	10.2	12.3	7.6	4.7	12.8	9.4	2.1	2.0
16	......	102	.....	96	99.3*	.....	108	.....	92	100.7*	..	7.4	....	13.2	10.3*	......	9.0	......	13.3	11.1*	6.1*	4.9

*Not included in 1930. Data are for 1931 only.
†Data are for standard strength fertilizer only. All other data are averages for standard and concentrated fertilizers.

TABLE 2.—Effect of Fertilizer Placement on Stand, Early Height, and Yield of Corn—Continued

Wooster and Columbus, 1930 and 1931

Place-ment No.	Final stand as per cent of check average										Height increase over checks approx. 6 weeks after planting										Yield—Av. increase over check 15½% moisture	
	200 lb. 4-12-4 per acre					400 lb. 4-12-4 per acre					200 lb. 4-12-4 per acre					400 lb. 4-12-4 per acre						
	Wooster		Columbus		Av.	Wooster		Columbus		Av.	Wooster		Columbus		Av.	Wooster		Columbus		Av.		
	1930	1931	1930	1931		1930	1931	1930	1931		1930	1931	1930	1931		1930	1931	1930	1931		200 lb.	400 lb.
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	Bu.	Bu.
	Fertilizer placed directly above seed but over increasing areas																					
1	63	60	9	63	48.5	25	25	0	29	20.0	8.0	−7.9	−2.0	2.0	0.1	1.9	−13.3	0.0	−4.5	−4.0	−12.4	−28.3
10	99	101	74	93	91.0†	64	70	33	78	61.2†	11.8	4.9	6.1	11.0	8.3†	10.8	1.7	1.9	7.2	4.0†	0.7†	− 5.6†
9	94	103	95	93	95.1	95	86	68	93	84.8	19.2	5.7	5.9	10.9	10.5	18.0	3.6	4.0	10.7	9.1	3.4	− 0.2
	Rectangular band above seed compared to mixing fertilizer with soil over similar area and to 1½-inch depth																					
10	99	101	74	93	91.0†	64	70	33	78	61.2†	11.8	4.9	6.1	11.0	8.3†	10.8	1.7	1.9	7.2	4.0†	0.7†	− 5.6†
11	78	100	89	92	88.5†	34	43	59	75	52.6†	13.2	5.6	6.9	11.8	9.9†	7.3	−3.1	2.5	7.3	3.0†	1.2	− 8.6†
	Actual stand of checks—perfect = 48 plants										Actual height of checks										Yields of checks	
	46.0	40.6	45.2	47.8	44.9	46.3	41.0	45.3	47.7	45.1	17.3	44.8	21.8	15.7	24.9	16.7	44.4	22.5	16.0	24.9	39.2	39.6

*Not included in 1930. Data are for 1931 only.
†Data are for standard strength fertilizer only. All other data are averages for standard and concentrated fertilizers.

efficient, especially at the 200-pound rate. Height data indicate a slight progressive increase in efficiency from increasing the depth from ¾ inch to 2½ inches. Variations in yield increases for placements within this range are of doubtful significance.

Area of fertilizer band placed above seed.—It is evident that where the fertilizer is placed ¾ inch above the seed in a continuous band, appreciable damage to stand has been prevented only in the case of the lower rate spread over the largest area, 63.6 square inches. (A 9-inch circle, actual fertilizer concentration, 0.14 ounce 4-12-4 per square inch). Height and yield data also indicate that any greater concentration above the seed has resulted in impaired efficiency.

Band placed above seed vs. fertilizer mixed with soil.—Where the area covered by the fertilizer has been that of a 4-inch x 7.9-inch rectangle, mixing the fertilizer with the upper 1½ inches of soil has not been superior to placing it in a single band ¾ inch above the seed, as regards either safety or efficiency. Both methods have been unsatisfactory, although not in all cases at the 200-pound rate.

Conclusions.—The data, as a whole, appear to favor placing the fertilizer either in a circular band, approximately 2 inches wide and 3 inches inside diameter, or in two parallel lateral bands, each about 2 inches x 8 inches and separated 3 inches, giving in either case a minimum horizontal distance of about ¾ inch between the seed and fertilizer. As regards depth, the fertilizer band should probably lie within a zone from ¾ inch above to 1 inch below the seed, the evidence being slightly in favor of the deeper placement.

CORN PLANTER TESTS

In addition to the hand placement experiments, tests have been run since 1929 at Wooster with various makes of commercial corn planters (a) to determine how various types of fertilizer depositors place fertilizer in respect to the hill of corn; (b) to determine the efficiency of these types, as measured by stand, height, and yield of corn; and (c) to furnish corn planter manufacturers with authoritative data which would serve as a guide to their efforts for further improvements in the design of fertilizer depositors. Six commercial planters were used in 1929, eight in 1930, and seven in 1931. Inasmuch as this is a progress report, only a few of the more important inferences will be presented here; complete data for all planters and detailed descriptions of methods will be reserved for publication after the work is concluded.

The record areas of the corn planter test consisted of triplicate plots, each containing at least 25 consecutive hills for each side of each planter. The hills were 42 inches apart each way, and the planters were set for four-kernel hills. Four applications at the rate of 100 pounds, 200 pounds, 300 pounds, and 400 pounds of a 4-12-4 fertilizer per acre were used.

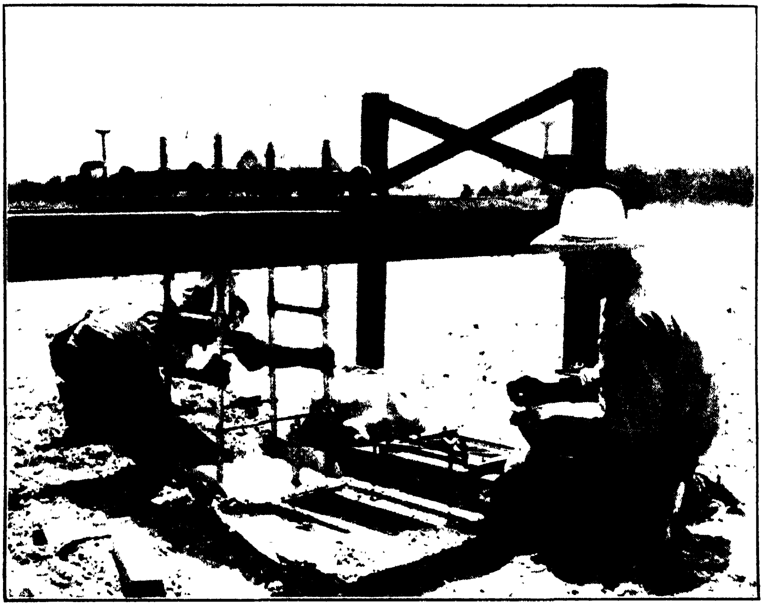


Fig. 3.—Special apparatus used in Ohio tests to determine how fertilizer was placed with respect to the seed

How the fertilizer was placed by the various planters was determined by the Ohio multiple plane method, a new system designed by the Agricultural Engineering Department. Briefly, this method consists of taking off a series of layers of soil one-quarter inch thick and recording what is seen on the top plane of each successive layer. The special layer-lifting and reading apparatus for this purpose is shown in Figure 3. From the field record of placement, large blue-line prints are made showing relative placement of fertilizer and seeds in the XY, XZ, and YZ planes. The manufacturers receive copies of the agronomic data, sets of blue-line prints showing how their machines placed fertilizer, and interpretations of results relative to placement.

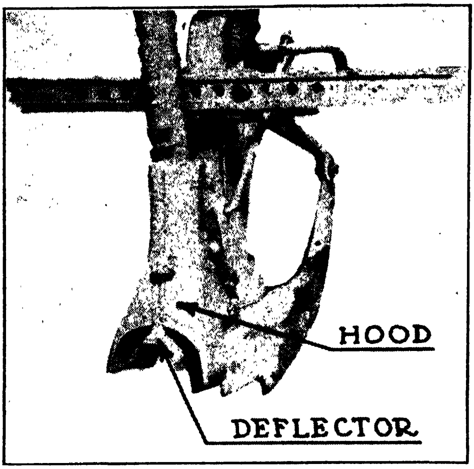


Fig. 4.—One type of modern fertilizer depositor

Figure 4 shows a type of modern fertilizer depositor. The function of the deflector is to split the fertilizer stream and to deflect one-half of the application to each side of the hill. The purpose of the hood is to widen the furrow opened by the corn planter shoe and to hold back the incoming soil until the fertilizer has reached the bottom of the furrow. When a deflector is used without a hood, the incoming soil is quite apt to reunite the two halves of the fertilizer stream and carry the fertilizer back to a position over, or in contact with, the seed.

As a rule, present depositors form four general classes:

1. Those equipped with neither deflectors nor hoods.
2. Those equipped with deflectors but no hoods.
3. Those equipped with both deflectors and hoods.
4. Specials, such as those equipped with stirring blades.

All planters used in the Ohio tests fall within those four groups, with the exception of the Station's experimental planter which carries very special design in an attempt to secure mechanically two fertilizer bands per hill, each band being fully 2 inches wide and 7 inches long, and the bands spaced 3 inches apart equidistant from the seed.

To show inferences regarding the effect of design upon stand, height, and yield, pertinent data from five planters for the 3 years are given in Table 3. This table indicates, also, how the depositor of each planter was equipped each year.

The seasons of 1929 and 1931 were both favorable, the rainfall during May and June being near normal or above and the response to fertilizer in growth and yield satisfactory. The land employed in 1931 was lower in fertility than that of 1929, the unfertilized yields were lower and the response to fertilizers higher. As previously noted, the season of 1930 was highly abnormal, rainfall being markedly deficient and evaporation high throughout the season. Damage to stand for a given machine and rate was in some

TABLE 3.—Comparative Performance of Corn Planter Fertilizer Distributors in 1929, 1930, and 1931

Planter	Year	How fertilizer depositor was equipped	Stand Per cent of check				Height Increase over check				Yield Increase over check				Average unfertilized		
		Rate ☞	100	200	300	400	100	200	300	400	100	200	300	400	Stand, per hill	Height, total	Yield, total
			Pct.	*Pct.*	*Pct.*	*Pct.*	*In.*	*In.*	*In.*	*In.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*No.*	*In.*	*Bu.*
A	1929	Deflector, no hood	74.5	61.0	50.5	47.0	19.8	20.9	23.5	19.0	5.2	0.2	− 8.6	−13.5	3.54	53.5	43.3
	1930	Deflector, no hood	98.5	90 9	95.9	92.6	9.0	7.5	5.0	4.5	−2.7	0.8	0.0	− 0.9	3.72	26.3	24.0
	1931	Deflector and hood	100.0	102.1	87.5	73.0	13.1	22.1	21.2	21.6	16.2	18.0	18.5	13.5	3.49	24.9	35.6
B	1929	No deflector, no hood	64.0	67.5	41.5	30.0	15.2	19.4	19.6	20.1	−1.7	−2.3	−18.0	−29.1	3.58	54.5	47.7
	1930	No deflector, no hood (see*)	91.1	107.9	99.5	101.3	0.0	−0.5	−0.5	1.5	0.4	−2.4	− 0.1	− 3.7	3.69	25.0	26.4
	1931	Deflector and hood	127.4	96.6	87.7	89.6	14.0	25.1	20.2	20.9	11.1	16.9	13.9	21.4	3.52	25.4	36.2
C	1929	Deflector, no hood	94.0	86.0	91.5†	88.5	6.2	11.7	12.5	20.3	1.9	5.5	2.7	7.9	3.93	57.3	41.5
	1930	Deflector, no hood	97.7	99.1	98.6	87.6	7.5	9.0	6.5	2.0	−0.8	−1.8	− 0.2	− 0.4	3.75	25.8	25.0
	1931	Deflector and hood	103.7	94.3	68.3	75.7	17.8	21.8	20.6	21.2	19.1	18.8	10.2	13.4	3.29	24.8	29.4
D	1929	Deflector and hood	92.5	89.0	81.5	71.0	13.6	26.7	21.3	23.9	6.2	12.0	11.4	− 0.5	3.47	52.8	37.4
	1930	Deflector and hood	65.6‡	81.9‡	90.6	71.1	2.0	10.0	4.5	1.5	−6.8	−2 3	− 0.9	− 5.2	4.85	28.1	24.8
	1931	Deflector and hood	101.0	114.7	94.0	72.8	14.9	20.6	23.8	15.8	15.4	23.5	24.7	4.0	3.37	25.5	34.9
E	1929	§O. A. E. S. experimental	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	1930	planter, especially designed	97.7	101.0	91.2	97.5	6.0	10.5	10.5	10.0	2.0	2.7	6.7	1.0	3.66	25.9	23.1
	1931	for band placement	100.0	100.0	98.8	101.0	14.0	20.4	21.0	22.4	11.4	22.7	19.5	20.6	3.50	25.1	36.6

*At manufacturers' request, planter set in 1930 to place fertilizer about half way between hills.
†Seed valve trouble.
‡Bird injury.
§Not used in 1929.

cases less in 1930 than in the previous year, probably because moisture was so lacking as to inhibit fertilizer movement to the extent that a minimum of separation of seed and fertilizer, either vertical or horizontal, was effective in preventing injury. Fair response in early height was observed, but almost no response in yield. It is believed that the data as a whole can be best interpreted by comparing the results for 1929 and 1931. To facilitate this comparison the data for these years are presented graphically in Figure 5.

The following remarks regarding these planters will be of interest. In perusing these statements it is well to keep in mind that some loss in stand, due to fertilizer application, may be tolerated providing an increase in yield more than compensates for the loss of plants. Also, at the present stage of development of fertilizer depositors, the test work thus far does not show economic justification for applications over 200 pounds per acre when all of the fertilizer is applied to the hills of corn spaced 42 inches apart.

Planter A.—In 1929, Planter A placed the fertilizer directly over and about an inch higher than the kernels of corn. The deflector split the fertilizer stream, but, probably resulting from the absence of a hood, the incoming soil reunited the stream and the covering soil dropped into place before the fertilizer had reached the seed plane. Planting was followed by a rain which, undoubtedly, carried some fertilizer salts downward into contact with the seed, and the shoots from kernels which sprouted had to pass through a layer of fertilizer. The result of such placement was a serious loss in stand at all applications and a correspondingly poor showing in yield, with even negative results in yield at the higher applications.

By 1931, the manufacturer of this planter had added a hood to the depositor, and the 1931 stand and yield results seem to indicate, thus far, that the change in design is a decided improvement. It must be remembered, however, that this new depositor has been included in the test only one year.

Planter B.—In 1929, this planter carried neither a deflector nor a hood; it placed a little of the fertilizer in contact with the seed at the lighter applications and pulled the balance of the charge ahead of the hill; at the heavier applications it placed more fertilizer in direct contact with the kernels. The detrimental results from such placement are shown in Table 3 and in Figure 5.

This planter gave such poor results in 1929 that the manufacturer asked to have the machine set in 1930 to place the fertilizer about half way between the hills in the row. It is interesting to

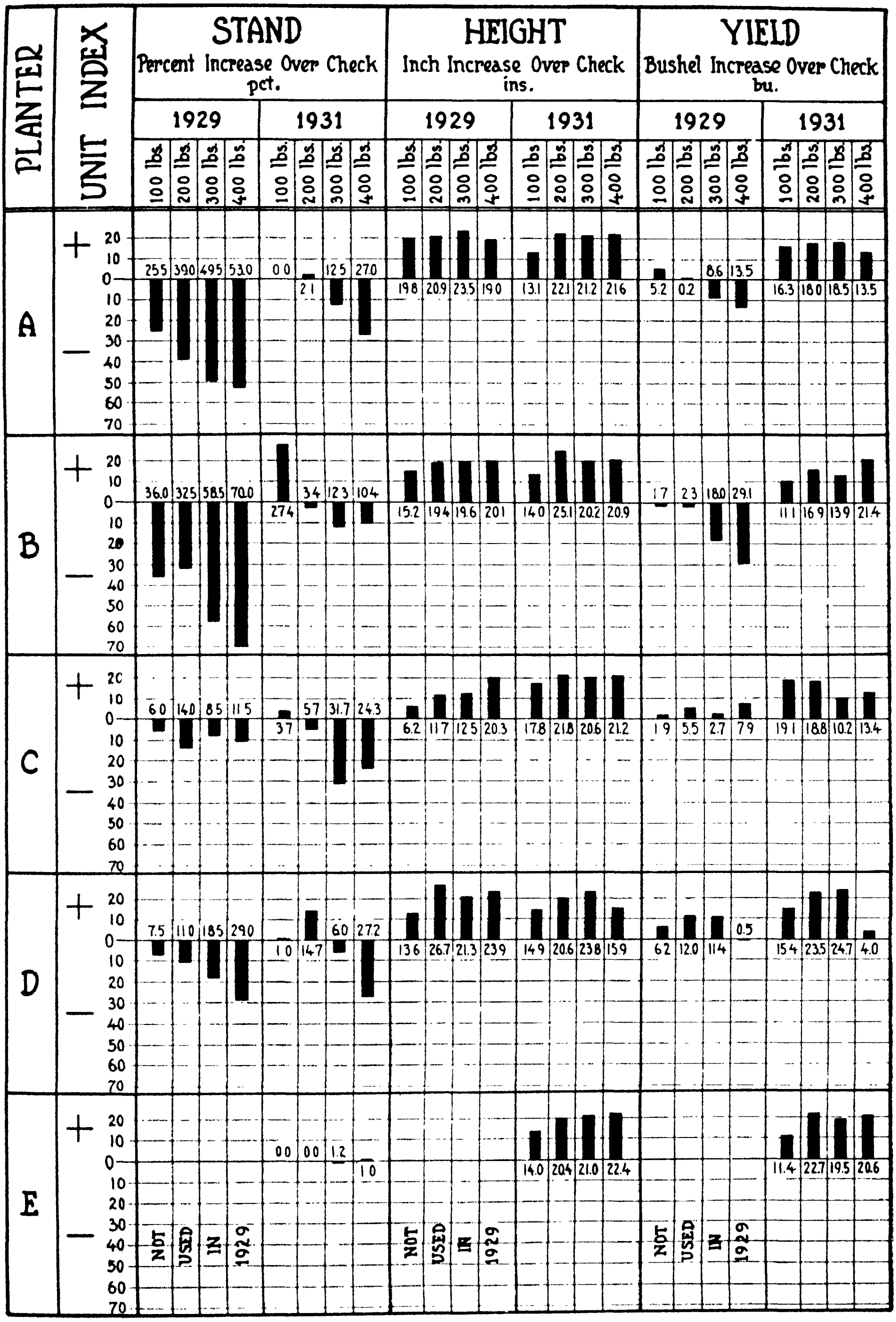


Fig. 5.—Graphic presentation of some relationships in Table 3 indicating progress in the design of fertilizer depositors

note in Table 3 that such excessive spacing between hills and fertilizer in 1930 prevented the stand losses of 1929, but the fertilizer was so far from the kernels that it had little if any effect during the early part of the 1930 growing season.

In 1931 the manufacturer of Planter B came into the market with a new depositor equipped with both a deflector and a hood. That this is an improvement is evident in both Table 3 and Figure 5, although it must be remembered that this depositor has been used only one season. The yield gains for the 300- and 400-pound applications in 1931 for both Planters A and B are interesting in that the stand losses in those tests were rather high.

Planter C.—When Planter C was equipped with a deflector only, as in 1929, it dropped the fertilizer a trifle ahead of the seed and drew it out into a long, narrow band. The loss of stand in 1929 is hard to account for, but the height and yield data indicate that the bulk of the fertilizer was somewhat too far from the hills to give good efficiency.

In 1931 the manufacturer offered a new depositor, equipped with deflector and hood, which places a rather narrow band of fertilizer on each side of and fairly close to the seed. The stand data for 1931 seem to indicate that the fertilizer may not be too close for the lighter applications but that some damage results with the higher rates. It will be noticed, however, that the 1931 attachment shows better results than the 1929 device in height and yield; this is due, probably, to the fact that the more modern depositor is placing the fertilizer closer to the hill where it is more efficient during the early growth of the plants.

Planter D.—This planter has carried a deflector and hood during the 3 years of testing work, and Figure 5 indicates that comparative results between 1929 and 1931 are fairly consistent. The depositors of this machine place a band of fertilizer on each side of the hill, with the bands timed well with the kernels. These bands are maintained fairly well at the lighter applications, but, as the quantity of fertilizer is increased to 300 pounds per acre, the band formation tends to break until, at 400 pounds, some fertilizer is in contact with or directly above the seed. The effect of this behavior is evident in the data and bars.

Planter E.—This experimental planter carries a special fertilizer boot on each side of the planter; each boot has two fertilizer valves 2 inches wide, and the fertilizer stream is split before the material reaches the valves. Each boot opens a furrow 7 inches wide, so that ample space is given laterally for two bands 3 inches

apart, with each band 2 inches wide. The depositor is so arranged that all covering soil drops downward into place instead of moving in from the side and the seeds are protected until the fertilizer bands have been partially covered. The machine was built in an attempt to place fertilizer mechanically in two bands fully 2 inches wide; it was not built as a pattern for commercial adaptation in its entirety, but manufacturers have copied from it some points which have practical possibilities.

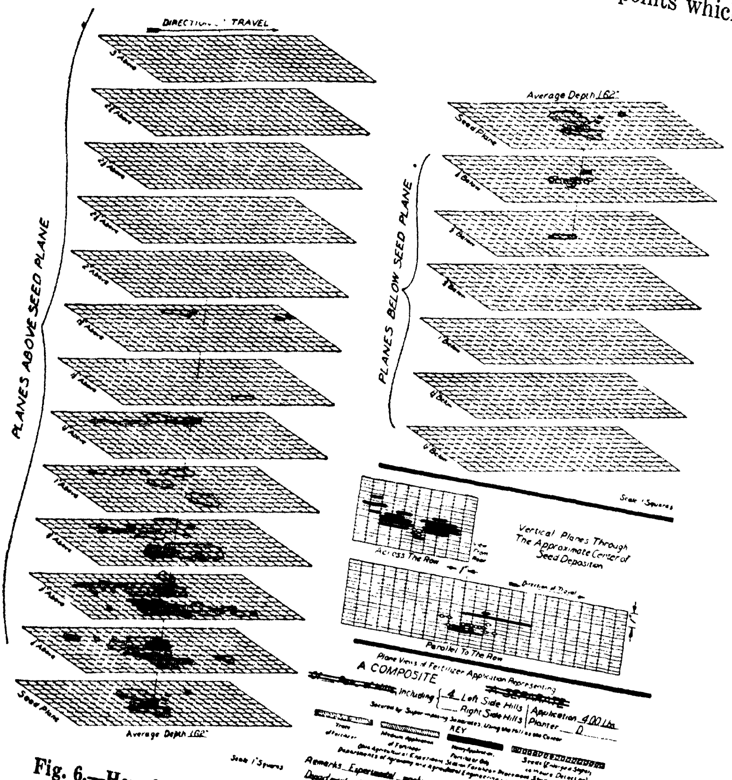


Fig. 6.—How fertilizer was placed by Planter E, as shown by a composite study of some 400-pound applications

Although the experimenters did not succeed in securing perfect bands with Planter E, nevertheless wide band formation is being approached as indicated by the vertical cross section near the center of Figure 6, which shows views of a composite study of placement.

That Planter E places fertilizer safely, from the standpoint of germination, is evident from the stand data. At the lighter applications, the fertilizer may be a little too far from the seed to give best efficiency, but it should be noted that at the higher rates of application both the height and yield results show favorably, with no loss in stand.

This brief progress report is made public to bring out some pertinent inferences regarding fertilizer placement and regarding what thus far seem improvements in a common type of design of fertilizer depositors for hill applications. The report does not intimate that fertilizer depositors are yet perfected, and no statement herein is to be construed to mean that less common types of depositors are not efficient.

EXPERIENCES IN PASTURING SUDAN GRASS

J. S. CUTLER AND W. E. WEAVER[1]

All dairymen are well aware of the usual pasture shortage in midsummer. With the coming of hot summer weather, the blue grass in a permanent pasture grows slowly, if at all, sometimes becoming brown and dry, as in 1930, and the dry or slow-growing grass is relatively unpalatable.

To the dairyman this is of primary concern since a pasture shortage, either in amount or quality, directly affects milk flow. It is well recognized that, once milk production falls off, it is extremely difficult to bring it back to the original level. Some dairymen circumvent this pasture shortage through the feeding of corn silage, having a smaller silo filled expressly for this purpose, but feeding corn silage in midsummer "goes against the grain" with some dairymen. The time and energy devoted to producing corn silage make it a costly "pasture" crop. Certainly, one can grow a pasture crop much more cheaply than ensilage, since no harvesting costs are involved.

SUDAN GRASS PASTURE

Sudan grass has been successfully used as a supplementary summer pasture for dairy cows for the past 3 years at the Hamilton County Experiment Farm. It was indispensable during the drouth

[1]Superintendent, Hamilton County Experiment Farm.

year of 1930 when the blue grass was killed out in large areas in the permanent pasture. Everyone seeing the field of Sudan grass was much impressed with its ability to produce pasture under the prevailing adverse conditions.

No difficulty was experienced with forage poisoning at the Hamilton County Experiment Farm in 1930, although some cases were reported in Kentucky, where the drouth was more severe than in Ohio, from pasturing badly stunted Sudan grass. This is less likely to happen with Sudan grass than with the larger growing sorghums.

Sudan grass has one advantage over leguminous pastures since it does not cause bloating. The experience at the Hamilton County Experiment Farm has been that the cattle will fill up in less time on Sudan grass and, thus, spend more time in the shade and away from flies.

Information on Sudan grass pasture for dairy cattle is meager. Thompson[2] reports a test at Dodge City, Kansas, in which 3 acres of Sudan grass seeded May 20 at 25 pounds per acre and pastured from June 24 to July 8, July 27 to August 12, and September 14 to September 21 produced 375 pasture days for one animal. The milk flow was increased on an average of 3.2 pounds daily per head each time the cows were turned on Sudan grass.

Call and Fitch[3] report an experiment at the Kansas Agricultural Experiment Station in which six Holstein cows were pastured on Sudan grass from July 10 to October 11, 1919. They were fed a grain mixture at the rate of 1 pound to each 4 pounds of milk produced. The returns were $47.47 an acre above the value of the grain feed, with butterfat at market prices and skimmilk at 50 cents a hundred. This included 1½ tons of hay per acre, which was harvested to keep the Sudan grass from getting too rank a growth. Figuring whole milk at 30 cents a gallon, the returns amounted to $73.55 above the cost of the feed consumed.

PASTURING EXPERIENCES

The date on which Sudan grass is ready to pasture varies with the season. The rapidity of the early growth depends upon temperature and adequate moisture—the higher the temperature, the more vigorous is the growth. The experiences at the Hamilton County Experiment Farm are presented in Table 1.

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[2]Thompson, G. E., Kan. Agr. Exp. Sta. Bull. 212, 1916.

[3]Call, L. E. and Fitch, J. B. Sudan Grass as a Supplementary Pasture Crop for Dairy Cattle. Kan. Agr. Exp. Sta. Cir. 80, 4 p., 1920.

TABLE 1.—Cultural Data on Sudan Grass Pasture

Year	Field	Acreage	Date sown	Rate per acre	Date pasturing started
1929	2A North	7	June 15	30	July 15
1930	2A South	5	June 14	30	Aug. 1
1931	2A South	5	May 27	30	July 6
	2A North	7	July 8	30	Aug. 6

Pasturing can begin when the crop is 1 foot high, although a growth of 2 feet is preferable. The 3 years' experiences indicate that the minimum time between sowing and the time the Sudan grass is ready for pasturing is 30 days. Although no exact experimental comparisons have been made, some data are available as to milk flow and carrying capacity.

EFFECT ON MILK FLOW

Through the use of Sudan grass pasture as a supplement to the permanent blue-grass pasture, it has been possible to maintain the milk flow during midsummer when a reduction usually occurs. These data are presented in Table 2. The average daily milk production is given individually for four cows that were in good production during the three summer periods. The average of eight good-producing cows was taken rather than the herd average, since it was felt that cows near the close of the lactation period would show little effect.

TABLE 2.—Effect of Supplementary Sudan-grass Pasture on Milk Flow

Year	Period	Pasture	Average daily milk production				
			Cow No.				Average 8 good-producing cows
			16	26	51	31	
1929	July 7-16	Blue grass	32.0	30.9	29.0	28.6	25.5
	July 18-27	Blue grass + Sudan grass	37.0	33.2	30.8	31.0	28.1
1930	July 22-31	Blue grass	29.7	19.2	23.4	28.1	26.6
	Aug. 1-10	Blue grass + Sudan grass	30.3	21.2	27.9	30.5	29.2
	Aug. 16-20	Blue grass + Sudan grass	28.9	18.9	20.9	25.2	26.4
	Aug. 21-27	Blue grass	28.1	18.7	19.7	23.0	25.6
	Aug.28-Sept.6	Blue grass + Sudan grass	27.6	18.3	19.0	25.4	26.0
	Sept. 7-14	Blue grass	25.8	16.2	15.0	24.5	24.0
1931	June 27-July 6	Blue grass	28.0	29.5	23.9	28.9	25.4
	July 7-16	Blue grass + Sudan grass	29.4	32.1	26.3	30.7	27.4
	July 17-26	Blue grass + Sudan grass	29.5	28.3	23.9	27.5	25.4

AMOUNT OF PASTURE FURNISHED

Because of the fact that the cattle had access to other pasture at all times, no exact figures can be furnished on carrying capacity. It was also found necessary to give the Sudan grass a rest occasion-

ally, so that it was never pastured continuously. The pasturing periods, amount of pasture furnished, supplemental feeds, and kind and condition of other pasture are given in Table 3. The figures in 1930 do not tell the whole story, as there was a time when the Sudan grass furnished the only green pasture. Considering the growth of the Sudan grass, 1929 might be termed a good Sudan-grass year, 1931 an average year, and 1930 a poor year.

GROWING THE CROP

Adaptation.—Sudan grass is one of the most easily grown and dependable of the one-season hay or pasture crops. Although larger yields are secured on good soil, Sudan grass does as well on poor soil as any crop and better than most. However, Sudan grass will respond to a light application of superphosphate; lime need not be used. Cold, wet soils are particularly unsuited to Sudan grass. Sudan grass is adapted anywhere in Ohio, but better results are secured in the southern half of the State because of the longer seasons.

Preparing the land.—A smooth, firm seedbed, on which the weeds have been pretty well killed in working, is preferred, since Sudan grass grows slowly at first. After it has become established, it will choke out most weeds through its rapid growth and may be used as a weed smothering crop. Plenty of moisture is necessary for germination. A July sowing in 1930, following oats pastured off, failed to germinate because of lack of moisture.

Time of seeding.—Sudan grass yields best in Ohio when sown from May 25 to June 10. Since the crop is semi-tropical in its temperature requirements, the soil should be thoroughly warm before it is sown, in order that growth may start as rapidly as possible. A seeding was made April 14 at the Hamilton County Experiment Farm in 1931, but only a scattered stand resulted. Usually, there is no gain, and frequently a loss, from seeding earlier than 2 weeks after corn planting.

Hughes and Wilkins[4] report a 4-year average yield of Sudan grass hay as follows: May 3, 4.46 tons; May 31, 4.38 tons; June 14, 3.58 tons; June 28, 2.57 tons; July 12, 2.09 tons; July 26, 1.32 tons; ranging from 4.46 tons seeded May 3, 3.58 tons seeded June 14, to 1.32 tons seeded July 26. The yields fell off very rapidly after the middle of June. Scattered tests[5] at the Ohio State University are in agreement with these data.

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[4]Hughes, H. D. and Wilkins, F. S. Sudan Grass. Iowa Agr. Exp. Sta. Bull. 233, 1926.
[5]Unpublished data.

TABLE 3.—Pasturing Sudan Grass
Hamilton County Experiment Farm

Year	Period	Dates pastured	No. days	No. cows	Hours per day	Total pasture hours	Supplemental feeds: Hay	Supplemental feeds: Grain	Supplemental feeds: Green corn	Notes on Sudan grass	Other pasture
							Lb.	Lb.	Lb.		
1929	1	July 18-31	14	23	8	2576	....	1442	....	2 feet high.	Fair blue grass.
1929	2	Aug. 1-31	31	23	6	4278	....	3193	....	....	Blue grass short. Turned on sweet clover in wheat stubble, Aug. 22.
1929	3	Sept. 1-30	30	23	4	2760	....	3105	....	....	Fair blue grass. Cows on sweet clover 4 hours each morning.
1929	4	Oct. 1-22	22	22	1	484	....	....	....	Very little Sudan—cows work it once daily.	Blue grass.
1930	1	Aug. 1-20	20	23	8	3680	....	2637	10630	Growth slow—delayed time of turning in.	Blue grass dry and dead.
1930	2	Aug. 28-Sept. 6	10	23	8	1840	630	1465	....	....	Blue grass dry and dead.
1930	3	Sept. 15-22	8	23	6	1104	630	1050	2160	Sudan grass eaten down closely.	
1930	4	Oct. 1-6	6	23	5	690	890	765	....	Only green pasture or meadow on farm.	Blue grass dry and dead.
1930	5	Oct. 10-18	9	23	5	1035	950	1040	....		Blue grass furnishing a little pasture.
1931	1	July 6-16	11	20	8	1760	......	785	.....	30 inches high.	Fair blue-grass pasture.
1931	2	July 17-Aug. 10	23	26	6	3588	....	2910	....	Growing more slowly than in 1929.	Blue grass failing.
1931	3	Sept. 1-20	20	20	4	1600	860	1990	....	Sudan grass becoming woody.	Blue grass failing.
1931	4	Sept. 21-Oct. 10	20	28	8	4480	1900	2720	....	Cattle grazed twice daily.	Practically no blue-grass pasture.

Rate of seeding.—Sudan grass stools so abundantly that the rate of seeding makes little difference in the final hay yield. Vinall and Getty[6] report average yields from humid regions of 2.91, 2.95, 3.02, and 2.87 tons of hay per acre from rates of 15, 20, 25-30, and 35-40 pounds per acre, respectively. Hughes and Wilkins[3] report 20 pounds as the most satisfactory rate of seeding for hay. The stems are somewhat finer at the heavier rates of seeding. A good standard recommendation is 20 pounds per acre for hay and about 25 pounds for pasture. The heavier rates of seeding are not to be recommended except on the more fertile soils.

Method of seeding.—Sudan grass can be sown with a grain drill, using the wheat side in a double feed drill. The crop should be drilled solid, like wheat or oats. The seed may be broadcasted and harrowed in, but more seed is required. The seed should not be sown too deeply, from 1 to 2 inches being best, depending on the soil. The shallower depth is preferable on the heavier soils. Cultipacking after seeding has usually proved beneficial.

Soybeans and Sudan grass.—Soybeans and Sudan grass grow well together, but the hay yields are less than those of Sudan grass alone. About 10 pounds of Sudan grass should be sown in addition

Fig. 1.—Left, Sudan grass sown May 15. Right, Sudan grass and soybeans sown May 15. Photographed August 11, at the Ohio State University

[6]Vinall, H. N. and Getty, R. E. Sudan Grass and Related Plants. U. S. Dept. of Agr. Bull. 981, 1921.

to a full seeding of soybeans. Both crops should be drilled together, using the grass seed attachment on the grain drill for seeding the Sudan grass. Varying results have been secured from mixing the seed of the two crops and sowing the mixture. Success appears to be dependent on the thoroughness of mixing and the size and shape of the soybean seed.

The soybean and Sudan grass mixture has been successfully used as supplemntary pasture for sheep at the Clermont County Experiment Farm. In 1930, the mixture was sown May 13 and pasturing started July 25, with the soybeans 11 inches high and the Sudan grass 28 inches high. In 1931, the mixture was sown May 25 and the sheep were turned in July 4; at this time, the soybeans were 14 inches high and the Sudan grass 28 inches. Pasturing should have begun earlier, since the Sudan grass got ahead of the sheep and 3 tons of hay were cut from about one-fourth of the 4.5-acre pasture lot.

ARSENICALS IN POTATO FLEA BEETLE CONTROL

HARRY L. GUI

Considerable difference of opinion has existed for some time concerning the control of the potato flea beetle, *Epitrix cucumeris* Harris, some maintaining that the customary bordeaux sprays were adequate for this purpose and others holding the view that the addition of an arsenical was desirable. Those favoring the addition of an arsenical were divided in opinion since some of this group preferred arsenate of lead and others arsenate of calcium. Even the strength of the bordeaux to be used was a matter of controversy, some believing that strong bordeaux was more effective than the standard mixture.

Previous to 1930, spraying experiments with this insect had been confined to detailed, small-scale laboratory tests in which both arsenicals showed superior control over bordeaux mixture and in which arsenate of calcium gave better results than arsenate of lead.

In order to supply the information demanded by the growers, extensive field tests were inaugurated in 1930 and continued on an enlarged scale in 1931. This article summarizes the data secured to date.

SPRAYING TESTS

The spray tests were conducted in cooperation with growers.[1] Each grower followed his customary cultural and fertility practices. In all the tests the plots were eight rows wide and contained not less than ½ acre each. Yield records were taken by harvesting the two middle rows of each plot, and from these data the yield per acre was calculated. Foliage damage was determined by collecting 25 representative leaves from each plot or a total of 100 for each treatment. The number of holes eaten in each leaf was counted, and the average number of holes per leaf was calculated. In 1932 about 400,000 holes were counted in the course of the investigation.

In so far as possible the sprays were applied at weekly intervals, and in all experiments each treatment was replicated four times in order to compensate for variations in conditions, such as differences in soil, degree of infestation by the beetles, etc. Both traction and power sprayers were used. A pressure of 300 pounds per square inch was maintained in making the applications. Approximately 100 gallons of spray material per application were used on each acre of potatoes under test. Special attention was given to the coverage of both under and upper surfaces of the leaves. In one case it was necessary to alter the standard Nixon boom by raising the nozzle above the row so that the lateral nozzles could be lowered sufficiently to obtain the best results.

In 1930 the work was confined to one 12-acre field at Wooster, but in 1931 a 14-acre field was used at Wooster and a 20-acre field at Bolivar. The Bolivar area was selected because flea beetle damage is consistently high in this locality.

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[1]The following growers cooperated in these investigations: The late Edgar Frick and Levi Dilyard, Wooster, Ohio, and Erwin Kline, Bolivar, Ohio.

The following tables summarize the results secured:

TABLE 1.—Potato Flea Beetle Control, Wooster, 1930

Number of sprays applied—9. Arsenicals used at rate of 4 lb. per 100 gal.
Variety—Cobbler

Treatment No.	Treatment Material	Average* number holes per leaf	Average yield per acre	Average gain over 4-6-50 bordeaux
			Bu.	*Bu.*
1	4-6-50 bordeaux	842	131	....
2	4-6-50 bordeaux; Calcium arsenate in 1st six	287	160	29
4	4-6-50 bordeaux; Lead arsenate in 1st six	299	146	15
5	4-6-50 bordeaux; Calcium arsenate in 1st three	529	141	10
6	4-6-50 bordeaux; Lead arsenate in 1st three	641	136	5
7	6-10-50 bordeaux	561	153	22

*In this and the following tables where the average is given it refers to the average of all the replicates of each treatment.

TABLE 2.—Potato Flea Beetle Control, 1931

Number of sprays applied—8. Arsenicals used at rate of 4 lb. per 100 gal.
Variety—Russet Rural

Treatment		Av. number holes per leaf		Av. yield per acre		Av. gain over 4-6-50 bordeaux	
No.	Material	Wooster	Bolivar	Wooster	Bolivar	Wooster	Bolivar
				Bu.	*Bu.*	*Bu.*	*Bu.*
1	4-6-50 bordeaux	167	177	243	181	....	....
2	4-6-50 bordeaux; Calcium arsenate in 1st six	127	93	271	222	28	41
3	4-6-50 bordeaux; Calcium arsenate in last four	149	92	268	194	25	19
4	4-6-50 bordeaux; Lead arsenate in 1st six	200	145	249	206	6	25
5	4-6-50 bordeaux; Calcium arsenate in 1st three	154	129	268	194	—5	33
6	4-6-50 bordeaux; Lead arsenate in 1st three	144	166	237	205	—6	24
7	6-10-50 bordeaux	179	204	251	187	8	6

TABLE 3.—Calculated Financial Returns from Potato Spraying Experiments

Calcium arsenate, per lb. \$.09. Lead arsenate, per lb. \$.15. Copper sulfate, per lb. \$.07. Hydrated lime, per lb. \$.01

Description	Treatment		Av. gain over 4-6-50 bordeaux	Insecticide used		Net returns per acre over 4-6-50 bordeaux		
	No.	Material		Amount	Cost	Potatoes @ \$.50 per bu.	Potatoes @ \$1.00 per bu.	Potatoes @ \$1.50 per bu.
			Bu.	*Lb.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
1930	2	4-6-50 bordeaux; Calcium arsenate in 1st six	29	24	2.16	12.34	26.84	41.34
Cobbler potatoes at Wooster	4	4-6-50 bordeaux; Calcium arsenate in 1st three	10	12	1.08	3.92	8.92	13.92
	5	4-6-50 bordeaux; Lead arsenate in 1st six	15	24	3.60	3.90	11.40	18.90
9 sprays	6	4-6-50 bordeaux; Lead arsenate in 1st three	5	12	1.80	.70	3.20	5.70
	7	6-10-50 bordeaux	22	Cu. 36; Lime 72	3.24	7.76	18.76	29.76
1931	2	4-6-50 bordeaux; Calcium arsenate in all	28	32	2.88	11.12	25.12	39.12
Russet Rural potatoes at Wooster	3	4-6-50 bordeaux; Calcium arsenate in last four	25	16	1.44	11.06	23.06	35.06
	4	4-6-50 bordeaux; Calcium arsenate in 1st four	6	16	1.44	1.56	4.56	7.56
	5	4-6-50 bordeaux; Lead arsenate in all	−5	32	4.80	−7.30	−9.80	−12.30
8 sprays	6	4-6-50 bordeaux; Lead arsenate in 1st four	−6	16	2.40	−5.40	−8.40	−10.40
	7	6-10-50 bordeaux	8	Cu. 32; Lime 64	2.88	1.12	5.12	9.12
1931	2	4-6-50 bordeaux; Calcium arsenate in all	41	32	2.88	17.62	38.12	58.62
Russet Rural potatoes at Bolivar	3	4-6-50 bordeaux; Calcium arsenate in last four	19	16	1.44	8.08	17.56	27.06
	4	4-6-50 bordeaux; Calcium arsenate in 1st four	25	16	1.44	11.08	23.56	36.06
	5	4-6-50 bordeaux; Lead arsenate in all	33	32	4.80	11.70	28.20	44.70
8 sprays	6	4-6-50 bordeaux; Lead arsenate in 1st four	24	16	2.40	9.50	21.60	33.60
	7	6-10-50 bordeaux	6	Cu. 32; Lime 64	2.88	.12	3.12	6.12

4-6-50 BORDEAUX VS. 6-10-50 BORDEAUX

During both seasons, 6-10-50 bordeaux (No. 7)[2] produced a higher yield of potatoes than did 4-6-50 bordeaux (No. 1).

It has been demonstrated that applications of bordeaux mixture are beneficial in aiding potatoes to withstand periods of drouth. The increased yield in 1930 probably was due to the effect of strong bordeaux on plant growth rather than to greater efficiency in flea beetle control. Upon examination of the data it will be seen that the average number of holes per leaf, even in the plots sprayed with the stronger mixtures, was relatively high.

Certainly in 1931 and probably during the average normal season, the increase in the net returns from strong bordeaux does not justify the extra expense involved in its use.

EARLY VS. LATE SPRAYING WITH CALCIUM ARSENATE

The value of calcium arsenate applied before midseason (No. 4), as compared with the same material applied after midseason (No. 3), depends upon the condition of growth of the potato crop. In the 1931 Wooster series the vines grew slowly during the early summer and made their best growth quite late. In this case the late-season treatments (No. 3) produced a higher yield than did the early-season treatments (No. 4). In the Bolivar series, however, where the most rapid growth took place early, the greater benefit accompanied early-season application (No. 4).

Both early- and late-season applications of calcium arsenate returned a profit, although in some cases this was quite small. In both fields more foliage injury was apparent at the end of the season when early-season applications were used.

CALCIUM ARSENATE VS. LEAD ARSENATE APPLIED EARLY

All replicates of plots sprayed with calcium arsenate before midseason (No. 4) produced a higher yield than did similar sprayings with arsenate of lead (No. 6). Calcium arsenate always resulted in an increase over the 4-6-50 bordeaux plots (No. 1); whereas, in one instance, the plots sprayed with arsenate of lead produced less than the bordeaux plots. The lower cost of calcium arsenate added considerably to the net profit returned.

[2]Numbers in parentheses refer to the treatments designated in Tables 1, 2, and 3.

CALCIUM ARSENATE VS. LEAD ARSENATE THROUGHOUT THE SEASON

Calcium arsenate when used in all the sprays (No. 2) produced better yields than did lead arsenate used in a like manner (No. 5). The difference in the cost of the two materials is important. In the case of the Wooster series in 1931, the lead arsenate plots failed to yield as well as the 4-6-50 bordeaux (No. 1) plots.

DUSTING TESTS

Because of the fact that many of the less extensive potato growers and some commercial growers depend on dusting for insect and disease control, it was deemed advisable to determine the value of arsenicals in the dusting program. These experiments were conducted in cooperation with F. H. Benton at Creston, Ohio. Russet Rural and Cobbler varieties growing on muck land were used. Data were collected in the same manner described under spraying tests.

The results of the season's work on Russet Rural potatoes are summarized in Table 4 and those on Cobblers in Table 5. The all-season and early-season application of calcium arsenate-copper-lime dust produced the heaviest yield of Rural potatoes with practically no difference between the two. The early-season application of the same dust outyielded the all-season schedule on Cobblers. Late-season arsenical applications did not consistently increase the yield of either variety.

In this series of plots the vine growth was vigorous from the start; hence, the results obtained regarding early- vs. late-season applications are consistent with those obtained in the sprayed plots.

TABLE 4.—Potato Flea Beetle Control by Dusts on Rural Russet Potatoes in 1931

Material*	Av. number of holes per leaf		Yield per acre			
			Field A		Field B	
	Field A	Field B	Average	Increase due to arsenical	Average	Increase due to arsenical
			Bu.	*Bu.*	*Bu.*	*Bu.*
20-80 copper-lime dust	157	74	276	....	247	....
20-80 copper-lime dust, 10% calcium arsenate in all	124	59	297	21	267	20
20-80 copper-lime dust, 10% calcium arsenate in 1st 4	102	71	294	18	269	22
20-80 copper-lime dust, 10% calcium arsenate in last 4	106	51	219	-57	253	6

*Eight applications were made on all plots during the season.

TABLE 5.—Potato Flea Beetle Control on Cobbler Potatoes in 1931

Material*	Average number holes per leaf	Yield per acre	
		Average	Increase due to arsenical
		Bu.	*Bu.*
20-80 copper-lime dust	338	370	....
20-80 copper-lime dust 10% calcium arsenate in all	264	381	11
20-80 copper-lime dust 10% calcium arsenate in 1st 3	303	411	41
20-80 copper-lime dust 10% calcium arsenate in last 3	262	385	15

*Six applications made on all plots during the season.

CONCLUSIONS AND RECOMMENDATIONS

The 2 years' experimental work herein reported indicates that calcium arsenate is the most efficient and economical arsenical to use with standard 4-6-50 bordeaux mixture or with 20-80 copper-lime dust for controlling the potato flea beetle on potatoes. It consistently produces higher yields and inhibits beetle damage to a greater degree than arsenate of lead. At the present market prices calcium arsenate costs considerably less.

The relative efficiency of early- and late-season applications of the arsenical depends upon the growth condition of the crop. Where the growth was rapid during the early season, the early applications were more effective than the late ones, and, conversely, where the early growth was slow and late growth rapid, the late applications of the arsenical were the more effective. Rate of growth cannot be predicted with certainty; therefore, the arsenical should be used throughout the season in order to insure the greatest returns. Particular attention should be given to spraying when the plants are growing rapidly.

Not less than eight applications should be made on Russet Rural or other late potatoes and at least six on Cobbler and other early varieties.

For spraying, 4 pounds of calcium arsenate should be added to each 100 gallons of bordeaux mixture.

For dusting, 1 pound of the arsenical should be used to each 10 pounds of 20-80 copper-lime dust. Mix thoroughly.

The use of greater than the normal strength bordeaux mixture does not appreciably increase the efficiency of the material in flea beetle control.

The potato flea beetle feeds largely on the under surface of the leaves. Care should be taken to cover both upper and lower leaf surfaces when spraying or dusting.

HOUSING CONDITIONS FOR CHICKENS IN CONFINEMENT

D. C. KENNARD

Heroic attempts are being made today by poultry keepers to master their problems and situations. Efforts are being made to control such disturbing factors as disease and parasites, sanitation, temperature, ventilation, light, and humidity. To accomplish these objects chicks are often brooded in confinement, and, likewise, the growing pullets and layers are frequently confined. Consequently, we have large-scale permanent brooding plants, battery brooders, multiple-floor laying houses, and now, the latest—batteries for layers. Commercial poultrymen have found it advisable to confine chickens of all ages for two sound reasons: (1) to control the uncertainties attending range methods and (2) to employ business and factory principles and methods of operation. Confinement practices have more or less solved some of the poultrymen's problems, but, as might be expected, new problems, particularly the vices of feather picking and cannibalism, have been introduced. In many instances these vices have become such a menace that poultrymen find it necessary either to adopt more severe methods of confinement whereby better control of uncertainties and disturbing factors can be secured or to reduce the scale of their operations and go back to range methods. However, one does not have to be an optimist to believe that the problems of confinement and intensified management practices will, in due time, be mastered.

The vices of feather picking and cannibalism can be effectively prevented either by proper control of light and temperature in brooding and laying houses or by the use of individual cages. Either procedure requires a different type of housing than has been commonly employed. It is obvious that poultry housing for confined birds in the near future is to be such a departure from the present that the poultry keeper who now proposes to build a new brooder or laying house faces a perplexing problem. There are ample reasons why he should not build according to customary plans, and yet the new and improved plans are still in the making.

It means that some one needs to do pioneering in the designing of brooder and laying houses to meet the needs and conditions involved in modern poultry keeping. However, experience along this line, meagre as it is, offers some suggestions.

WINDOWS

One of the most persistent mistakes of poultry housing in the past has been the use of too much glass. Glass makes the house cold at night and hot when the sun shines. Such radical changes of temperature are objectionable and may lead to serious consequences. When chickens of any age are confined, windows or open front spaces become a nuisance, since it is necessary to cover or color the windows and close the open spaces to keep out excess light in order to prevent or control feather picking and cannibalism. It seems that coloring the windows might prevent the vices, but this would necessitate keeping the windows closed the same as if the windows were covered to restrict the amount of light. A probable advantage of coloring the windows would be that sufficient light might be admitted so that it would not be necessary to use artificial light on cloudy days. However, the colored light, as sometimes employed, may prove irritating to the nerves and especially to the eyes of the caretaker. Whether it may have ill effects upon the chickens has not been demonstrated.

When a complete ration for indoor birds is employed, the principal function of windows or open front spaces is to provide ventilation to prevent excess heat in the house during warm weather. Consequently, the brooder or laying house without windows or with closed windows must have a dependable ventilating system or mechanical ventilation.

That feather picking and cannibalism can be prevented by proper control of light and temperature in the brooder or laying house need no longer be questioned. A typical instance of how light and temperature are determining factors in the cause of vices was demonstrated recently by a poultryman who claimed feather mites were causing his layers to lose their feathers. The pullets had lost their feathers, but the cause as usual was the vice of feather picking. He stated that the pullets in the laying house were so much worse than those in the barn and he wondered why. Upon going to the second floor of the barn, the birds were found to be in decidedly better condition. The reason was apparent. The remodeled barn quarters had less than half the corresponding window space and were cooler than the laying house. Just what

will be the proper amount of light to be maintained in a given brooder or laying house will vary greatly, depending upon a variety of determining factors such as the number of birds on a given floor space, age of birds, breed, climate, time of year, temperature, type of housing, direction the house faces, location of windows, availability and cost of artificial light, and whether the light is to be subdued for prevention or control of the vices. Certainly, a greater reduction of light will be required for control than for prevention. However, about one square foot of glass or open space to 50 square feet of floor area will usually prevent the vices, if the bottom of the sash is 4 to 5 feet above the floor. It is obvious that each poultryman must solve for himself the problems of the optimum amount of light and of the best method of administering and controlling it.

Fig. 1.—Light and temperature could have been controlled to serve the layers in this barn better had ventilation instead of windows been provided. Then one top sash would have served for each twin window.

In the brooder house at the Station's poultry plant, 3,000 to 4,000 January-hatched chicks can be brooded to 12 weeks of age with practically no feather picking or cannibalism if the windows are kept closed and covered with two layers of heavy brown wrapping paper to keep out the sunlight. This permits the use of controlled light to prevent the vices. On the other hand, much trouble is experienced with April-hatched chicks because of the warm

weather in May and June which necessitates the opening of the windows to keep down the excessive heat. When the windows are open, the light can no longer be controlled so as to prevent the vices. Obviously, the solution of the problem is to provide a ventilating system or mechanical ventilation that will control the temperature without having to open the windows. The windows could then be largely eliminated and this brooder house made more serviceable and comfortable both in winter and summer.

In the realm of possibilities which may prove determining factors in the design of future poultry buildings are the use of artificially-produced health-promoting rays and the use of colored or tinted glass to prevent feather picking and cannibalism and, at the same time, capable of transmitting the vital rays of direct sunlight. The former accomplishment might permit the elimination of windows; whereas the latter might offer a substantial reason for windows. If the use of a moderately priced, special, double-purpose glass would obviate the need for cod-liver oil or its equivalent in the ration, it might prove economical. However, regardless of the possible future capabilities of glass, there will probably be a need for providing the vitamin-D factor as a part of the ration or the exposure of indoor birds to artificially-produced health rays in climates where there is a prevalence of cloudy weather or during certain seasons of the year in other localities where this condition prevails.

CONTROLLED HOUSING CONDITIONS

Protection and controlled conditions are the main purpose of poultry housing. In the past, the primary object was to provide some protection against winter weather, particularly wind, rain, and snow. Compare this with present day requirements for control of temperature, ventilation, light, humidity, and sanitation. How shall the brooder and laying houses be designed to meet these requirements?

In the first place, it seems that the future brooder or laying house will be a well-constructed, properly insulated building rather than a coop or a shack, such as has generally been employed. Anyone who contemplates building a brooder or laying house is fortunate if he has a well-built barn or other building suitable for conversion into brooding and laying quarters where temperature, light, and ventilation can be controlled at will. Often poultrymen have made the mistake of going to the expense of putting windows in their barns only to find them a nuisance later. The barn without windows or a few small sash near the ceiling is preferable.

Those obliged to build new structures will need to do some pioneering in the designing of poultry buildings. It would seem that, in general, the new structures might embody the following suggestions: The width should be at least 30 feet, but may as well be 60 feet or more; the length, preferably from north to south, will depend upon the number of birds to be accommodated. A moderately sloped, double pitched or gable roof would be preferable. The ceilings may be 8 to 9 feet high so that there will be plenty of air space above should it ever be desired to install battery brooders or laying batteries.

Fig. 2.—A three-floor 42 x 72 building well adapted for confinement brooding and for layers.

The adjoining brooder house requires a means of ventilation which will permit the control of light and temperature during warm weather without opening the windows to prevent the vices of feather picking and cannibalism.

In case of the one-floor structure the top plates on each side may be 6 or 7 feet above the floor. Then, the inside lining or insulation can be applied to the lower edge of the rafters to a point 8 to 9 feet above the floor, then to ceiling supports which go horizontally across to a similar point on the opposite side and down the rafters to the opposite plate. This type of ceiling would likewise apply to the top ceiling in case of a multiple-floor building. There may be any number of floors desired. Should batteries be installed,

concrete or water-proofed floors would be an advantage because they could be kept wet in warm weather which, with ample ventilation, would aid greatly in moderating the temperature. The building would need to be thoroughly insulated so as to provide a comfortable temperature both winter and summer. It should have artificial heat, light, water under pressure, convenient feed storage, a convenient way of getting litter into the pens and the used litter and the droppings out of the pens, and a simple, inexpensive, dependable ventilating system or mechanical ventilation which can be installed at a moderate cost. The building in question may have no windows or a few small sash located next to the ceiling so that light, temperature, and ventilation can be effectively controlled.

The same type of building would serve equally well for brooding chicks, growing pullets, and the layers, except that, for brooding, additional heat, administered to suit the special needs of chicks, would be required.

CONCLUSION

The purpose of this article was to take an unconventional view point and frankly question some of our poultry housing beliefs and practices, particularly in reference to the admission of natural daylight. Some general suggestions have been offered. Just how the near-future poultry building may be designed and equipped best to serve present conditions, problems, and requirements can only be determined by future developments. If any of the suggestions should merit acceptance, the exact details will have to be worked out by further experience by means of the customary procedure of "trial and error" or by pioneering on the part of progressive poultrymen and others.

In the consideration of such problems we need to proceed with open minds in the light of today's experiences, conditions, and requirements and avoid being confused, handicapped, or prejudiced by traditional beliefs and practices of the past which may no longer be adaptable to our present conditions and problems.

INCREASING THE VITAMIN-D CONTENT OF MILK

W. E. KRAUSS, R. M. BETHKE, AND C. F. MONROE

Milk produced under ordinary conditions is a poor source of vitamin D, the factor essential for proper assimilation of the bone-building elements, calcium and phosphorus, which are abundant in milk. Direct experimental evidence has shown this to be true, and the high incidence of rickets in milk-fed infants offers indirect evidence of this fact. Not only milk but all natural foods are deficient in vitamin D. Because of this, it has become the practice during the winter to feed infants cod-liver oil or some other substance rich in vitamin D or to expose the children to rays from lamps radiating waves of light that act upon the skin to produce the same results obtained by summer sunshine. These practices are sometimes unpleasant and expensive, and, therefore, many infants never receive the benefits to be derived from them. It was apparent, then, that some cheap, common source of vitamin D should be found. The universal use of milk as a food suggested this product as the one which, if increased in vitamin D, would give the greatest benefit.

Many attempts have been made to increase the vitamin-D content of cow's milk. The results obtained have been indefinite and conflicting, except when cod-liver oil was fed. However, the amount of cod-liver oil required to increase the amount of vitamin D in milk appreciably had a depressing effect on the fat percentage. Based upon these previous rather unsuccessful efforts, attention was turned to the then most potent source of vitamin D known—irradiated ergosterol. (Ergosterol is obtained from the fungus causing the disease known as ergot of rye and from yeast. When treated with ultra-violet light ergosterol becomes highly active as an antirachitic substance. Irradiated ergosterol is sold on the market under the name of Viosterol.)

Preliminary work with one Jersey cow showed that, when 130,000 Steenbock rat units of irradiated ergosterol were fed, a several-fold increase in the vitamin-D content of the milk resulted. This stimulated further work. Consequently, two Holstein cows in approximately the same stage of lactation and producing about the same amount of milk were selected. These cows were kept under winter feeding conditions throughout, except for a short period each day when they were allowed to obtain water and to exercise in a barnyard free from vegetation. The dairy ration consisted of

alfalfa hay of fair quality, corn silage, corn, oats, bran, and linseed oilmeal. In order to have the quality of the hay uniform, sufficient hay was set aside at the beginning to last throughout the experiment.

The feeding trial was divided into five periods of 3 to 4 weeks' duration each. Periods 1, 4, and 7 were controls during which 50 cc. of corn oil (Mazola) were fed to equalize the additional fat intake during the ergosterol feeding periods. In periods 2, 3, 5, and 6 irradiated ergosterol was fed according to the schedule in Table 1. The pure corn oil (Mazola) of the ergosterol-corn oil mixture was mixed with the daily grain allowance of each cow.

TABLE 1.—Experimental Feeding Plan

Period and butterfat No.	Feeding period 1930	Supplement fed daily	Steenbock rat units of vitamin D fed daily
1	April 1-24 (24 days)	50 cc. corn oil	......
2	April 25-May 15 (21 days)	25 cc. ergosterol solution, 25 cc. corn oil	7,500
3	May 16-June 5 (21 days)	50 cc. ergosterol solution	15,000
4	June 6-July 10 (35 days)	50 cc. corn oil	....
5	July 11-31 (21 days)	10 cc. ergosterol solution, 40 cc. corn oil	100,000
6	Aug. 1-26 (26 days)	20 cc. ergosterol solution, 30 cc. corn oil	200,000
7	Aug. 27-Sept. 26 (31 days)	50 cc. corn oil	....

During Periods 2 and 3, ergosterol furnished by the Acetol Products Corporation, New Brunswick, New Jersey, was used; during Periods 5 and 6, ergosterol furnished by Standard Brands, Inc., New York City, was used.

During the last 5 days of each period the total amount of milk produced by both cows was collected and combined. This was separated and the cream churned. The resulting butter was then rendered into pure fat. The fat samples thus obtained were fed to rats, and the amount of vitamin D in them was determined. (In the tables the fat samples are numbered to correspond with the numbers of the periods during which they were taken).

Both the curative and prophylactic procedures for determining vitamin D were carried out. The curative, or "line-test", procedure consisted essentially of feeding different levels of butterfat to

rachitic rats until that level was found which produced definite evidence of healing. From this critical level of butterfat the number of rat units of vitamin D per gram was calculated. Table 2 shows the essential data obtained by the "line-test" procedure.

TABLE 2.—The Critical Amount of Butterfat Required, Daily, to Produce Definite Evidence of Healing in Rats

Fat sample	Rat units of vitamin D fed daily	No. of rats	Critical daily level of butterfat	Rat units of vitamin D per gram of butterfat
			Mg.	
1	0	10	600	0.17
2	7,500	5	350	0.29
3	15,000	4	200	0.50
4	0	5	120	0.83
5	100,000	5	60	1.67
6	200,000	5	40	2.50
7	0	4	250	0.40

From the data in Table 2 it will be seen that, as the vitamin-D intake of the cows increased, the anti-rachitic potency of the butterfat increased correspondingly, from 0.17 Steenbock rat units per gram during the control period (No. 1) to 2.5 units per gram where the vitamin-D intake, in the form of ergosterol, amounted to 200,000 rat units daily (Period 6).

The prophylactic procedure consisted essentially of feeding rats a rickets-producing diet, to which were added, daily, various amounts of the butterfats. At the end of 5 weeks, the rats were killed and their femurs removed. After removing the moisture and fat, the amount of ash in the femurs was determined. The results obtained by this procedure are presented in Table 3. In this table the higher the percentage of ash in the femurs was, the greater was the amount of vitamin D in the butterfat.

The data in Table 3 show that better calcification was obtained with 40 mg. of Butterfat *6* than with 600 mg. of Butterfat *1*, or, in other words, when 200,000 units of vitamin D were fed the anti-rachitic potency of the butterfat was at least 15 times as great as that obtained from feeding the ordinary dairy ration (Period 1). These results agree closely with those obtained by the "line-test" method.

TABLE 3.—The Effect of Different Samples of Butterfat on Calcification in Rats

Fat samples	Units of vitamin D fed to cows daily	Amount of butterfat fed daily	No. of rats	Average gain in weight	Average ash in femurs
		Mg.		*Gm.*	*Per cent*
1	0	400	5	28.6	37.72 ± 1.21
		600	5	33.2	43.71 ± 1.23
2	7,500	200	4	28.8	37.85 ± 1.46
		400	5	29.0	42.67 ± 0.29
3	15,000	100	5	28.6	32.59 ± 1.69
		200	4	36.0	41.43 ± 0.86
4	0	180	5	21.2	48.32 ± 0.41
		200	4	27.0	48.54 ± 0.32
		400	5	23.8	51.60 ± 0.48
5	100,000	80	5	41.4	50.11 ± 0.73
		100	4	29.8	51.94 ± 0.45
		200	5	32.6	54.17 ± 0.41
6	200,000	40	4	32.8	49.27 ± 0.89
		50	5	27.6	47.88 ± 0.61
		100	5	28.4	50.09 ± 0.32
		120	4	44.5	49.36 ± 0.62
7	0	100	5	41.2	38.12 ± 1.04
		200	5	46.8	44.42 ± 1.04
Negative controls			17	25.8	30.23 ± 0.57
Positive controls (2 per cent cod-liver oil)			16	31.3	50.55 ± 0.41

In order to obtain further information with another species as to the comparative calcifying values of Butterfats *4*, *5*, and *6*, the chick was chosen as the experimental animal. The prophylactic procedure, similar to that used with the rats, was followed. The data obtained with chicks are presented in Table 4. They substantiate the results obtained with the rats inasmuch as the ash content of the bones of chicks in Lot 6 (5 per cent of Butterfat *6*) is significantly greater than that of the bones of the chicks in Lot 2 (5 per cent of Butterfat *4*).

TABLE 4.—Effect of Different Samples of Butterfat on Calcification in Chicks

Lot No.	Per cent of fat substituted for corn oil in basal ration	Units of vitamin D per 100 gm. ration	Average weight at 6 weeks	Average ash in tibiae
			Gm.	*Per cent*
1	None	0	156.2	40.79 ± 0.38
2	5.0 per cent butterfat No. 4	4.2	241.7	43.59 ± 0.36
3	2.0 per cent butterfat No. 5	3.3	214.7	42.89 ± 0.46
4	5.0 per cent butterfat No. 5	8.3	213.2	44.34 ± 0.43
5	2.0 per cent butterfat No. 6	5.0	194.1	42.47 ± 0.29
6	5.0 per cent butterfat No. 6	12.5	228.2	45.76 ± 0.45
7	0.1 per cent cod-liver oil	3.3	305.9	47.53 ± 0.18
8	0.2 per cent cod-liver oil	6.7	292.9	50.08 ± 0.14
9	0.3 per cent cod-liver oil	10.0	310.4	49.60 ± 0.45
10	0.5 per cent cod-liver oil	16.7	298.4	50.79 ± 0.31

Since the human species is the one to be benefited by high vitamin-D milk, arrangements were made with Drs. H. J. Gerstenberger and A. J. Horesh of the Babies' and Children's Hospital in Cleveland to feed rachitic babies milk produced by cows receiving 200,000 rat units of irradiated ergosterol daily. Two rachitic babies fed one pint of this milk daily showed, by frequent X-ray examinations and blood studies, steady improvement up to the time they were removed from the hospital.

In addition to the effect upon the food value of the milk, consideration was given to the production and physical condition of the cows while on this feeding program. A study of the production records of the cows revealed no change in their milk and fat production over that obtaining over a similar period during the preceding lactation.

At the conclusion of the feeding period, the cows were slaughtered and a pathological study of their organs was made by Dr. Harry Goldblatt, of the Institute of Pathology at Western Reserve University, Cleveland. No abnormalities due to the feeding of irradiated ergosterol were found.

As a result of these studies it is concluded that the vitamin-D content of milk can be increased many times by feeding irradiated ergosterol to cows and that the producing ability and physical condition of the cows are not impaired by such a feeding program. However, the cost of the ergosterol, together with the inefficiency with which it is transferred to the milk, makes its general use prohibitive.

PURCHASE OF CANNERY TOMATOES ON GRADE RESULTS IN INCREASED RETURNS TO CANNERS

CHAS. W. HAUCK

Ohio canners who have bought tomatoes from growers on United States grades with government inspection have found it to be a valuable improvement over the former flat-rate system of buying. In addition to increasing average returns to growers by $1.38 per ton in 1930, this system has resulted in gains to canners.

The increased value to canners of tomatoes bought on grade may be illustrated by comparing the yields and computed values of the finished products manufactured from each ton of raw stock. Data for this comparison have been furnished by four companies operating five factories in Ohio, which bought on grade in 1930. Yields per ton in 1930 have been compared with the average yield per ton in the 5 years 1925 to 1929, inclusive, when tomatoes were bought by these companies on the flat-rate system.

TABLE 1.—Yield of Tomato Products in Five Ohio Factories, 1925-1930

Five factories combined	Total, 1925-1929 (Net weight, Lb.)	1930 (Net weight, Lb.)	Total 1925-1929 (Per cent of raw stock)	1930 (Per cent of raw stock)
Tomatoes received	28,531,800	12,139,060	100.0	100.0
Canned tomatoes packed: Fancy	1,476,105	416,685	5.2	3.4
Canned tomatoes packed: Extra Standard	5,080,320	3,338,835	17.8	27.5
Canned tomatoes packed: Standard	1,417,095	477,030	5.0	3.9
Other tomato products packed	5,625,993	2,228,575	19.7	18.4
Waste	14,932,287	5,677,935	52.3	46.8

Expressed in percentages of total pack rather than in terms of raw stock purchased, the products manufactured in 1925 to 1929 were proportioned as follows: Fancy tomatoes, 10.8%; Extra Standard tomatoes, 37.4%; Standard tomatoes, 10.4%; other products, 41.4%. In 1930 proportions were: Fancy tomatoes, 6.4%; Extra Standard tomatoes, 51.7%; Standard tomatoes, 7.4%; other products, 34.5%. Fancy and Extra Standard tomatoes rose in 1930 from 48.2% to 58.1%, while Standard tomatoes declined from 10.4% to 7.4%; and other products declined from 41.4% to 34.5%. The pack improved noticeably in quality.

TABLE 2.—Values of Tomato Products per Ton of Raw Stock in Five Ohio Factories, 1925-1930

Five factories combined	Average, 1925-1929 (Net weight, Lb.)	1930 (Net weight, Lb.)	Average, 1925-1929 (Doz. cans)	1930 (Doz. cans)	Price per doz.	Value per ton	
						Average, 1925-1929	1930
					Dol.	*Dol.*	*Dol.*
Tomatoes received	2000	2000					
Canned tomatoes packed: Fancy*	104	68	6.93	4.53	1.18	8.18	5.35
Canned tomatoes packed Extra Standard*	356	550	23.73	36.67	1.01	23.97	37.03
Canned tomatoes packed: Standard*	100	78	6.67	5.20	0.91	6.07	4.73
Other tomato products packed†	394	368	4.80	4.48	3.21	15.41	14.38
Totals						53.63	61.49

*Expressed in terms of No. 2 cans.
†Expressed in terms of pulp in No. 10 cans.

The gross sales values of these products have been computed at the 5-year average price level of 1926 to 1930. To simplify the comparisons, yields have been expressed in terms of No. 2 cans of canned tomatoes and No. 10 cans of pulp.

It will be observed that the computed gross sales value of the finished products manufactured from each ton of raw stock rose from $53.63 on the flat-rate system to $61.49 on the graded system, a gain of $7.86.

It has been seen that raw stock costs increased $1.38 per ton. Inspection charges at $50 per week per man totaled $2854.85 in 1930 and $5500.00 in 1931, or $0.31 per ton. Can requirements per ton under the graded system were larger than under the flat-rate system; at the 5-year average quotations, f. o. b. factory, during 1926 to 1930 of $20.99 per thousand No. 2 cans and $63.11 per thousand No. 10 cans, this increased can cost amounted to $2.04 per ton.

Based on labor costs reported by three of these companies operating four factories, savings in labor costs in manufacturing graded tomatoes, rather than ungraded, amounted to $0.28 per ton. Labor costs in these factories averaged $7.29 per ton during 1925 to 1929, inclusive, and $7.01 per ton in 1930. Wage rates in these factories had not changed materially in 1930 from the average of those prevailing during the preceding 5 years.

Net costs were thus $3.45 more per ton than when these canners were buying on flat rates. Deducting this amount from the gross increase of $7.86 in sales value of the finished products results in a net gain to the canner of $4.41 per ton of raw stock purchased.

A more reliable comparison can be made, of course, after a longer experience with the grading system. The evidence thus far obtained tends to indicate that the marketing of cannery tomatoes on grade and inspection results in (a) greater returns to growers, (b) lower labor costs and higher net returns to canners, (c) improved quality and larger volume of finished products per ton of raw stock, and (d) more equitable relationships between growers and canners.

TONNAGE OF COMMERCIAL FEEDS REACHING THE OHIO RETAIL TRADE IN 1929, 1930, AND 1931

V. R. WERTZ

There has been a tendency for Ohio farmers to buy less commercial feeds. This tendency is shown by the accompanying tabulation giving the tonnage of commercial feeds reaching the Ohio retail trade in 1929, 1930, and 1931, as reported by feed dealers licensed to sell feeds in Ohio. These figures are based on the tonnage reported by the same feed dealers selling to the Ohio retail trade over this 3-year period.

The total tonnage, as reported by these commercial feed dealers, decreased from 679,518 in 1929 to 575,570 in 1930 and to 410,104 in 1931. This was a decrease of 15 per cent in 1930 and a further drop of 29 per cent in 1931. The total tonnage, as reported for 1931, was 269,414 tons, or 40 per cent under that for 1929.

The greatest decrease in commercial feed sales was in mixed feeds. Mixed feed sales declined from 385,287 tons in 1929 to 289,512 in 1930 and to 174,704 in 1931. This was a decrease of 25 per cent from 1929 to 1930, 40 per cent from 1930 to 1931, and 55 per cent from 1929 to 1931.

The sale of unmixed feeds has, likewise, been on the decline since 1929, but not to the same extent as mixed feeds. The tonnage of unmixed feeds fell from 294,231 in 1929 to 286,058 in 1930 and to 235,400 in 1931, making a decrease of 3 per cent from 1929 to 1930, 18 per cent from 1930 to 1931, and 20 per cent from 1929 to 1931. As evidence of the fact that farmers are doing more of their own mixing and using a larger percentage of their home-grown feeds, some of the ingredients, such as alfalfa meal, tankage, and meat scraps, have actually increased over this period. Alfalfa meal sales increased from 4,757 tons in 1929 to 5,180 in 1930 and to 5,331 in 1931. Tankage increased from 8,834 in 1929 to 9,209 in 1930 and to 11,073 in 1931. Meat scraps likewise showed a gain over this period. The meat scrap tonnage increased from 12,230 in 1929 to 12,663 in 1930 and to 15,584 in 1931.

TABLE 1.—Commercial Feeds Reaching the Retail Trade in Ohio*
As reported by feed dealers licensed to sell feeds in the State in 1929, 1930, and 1931

	1929		1930		1931	
	Tons	Per cent of total	Tons	Per cent of total	Tons	Per cent of total
Mixed Feeds:						
Dairy feeds	130,467	19.2	104,178	18.1	57,825	14.1
Poultry feeds	192,304	28.3	142,166	24.7	91,453	22.3
Hog feeds	37,373	5.5	20,145	3.5	7,792	1.9
Other mixed feeds	25,143	3.7	23,023	4.0	17,634	4.3
Total mixed feeds.	385,287	56.7	289,512	50.3	174,704	42.6
Unmixed Feeds:						
Cottonseed meal	16,988	2.5	17,843	3.1	13,944	3.4
Oilmeal	24,463	3.6	27,052	4.7	22,146	5.4
Bran	60,477	8.9	54,103	9.4	54,134	13.2
Middlings	57,080	8.4	50,650	8.8	43,471	10.6
Alfalfa meal	4,757	0.7	5,180	0.9	5,331	1.3
Gluten feeds	20,386	3.0	21,296	3.7	18,865	4.6
Hominy	50,964	7.5	50,075	8.7	28,279	6.9
Tankage	8,834	1.3	9,209	1.6	11,073	2.7
Meat scraps	12,230	1.8	12,663	2.2	15,584	3.8
Milk products	2,038	0.3	1,727	0.3	1,640	0.4
All other feeds	36,014	5.3	36,260	6.3	20,915	5.1
Total unmixed feeds	294,231	43.3	286,058	49.7	235,400	57.4
Total (All commercial feeds)	679,518	100.	575,570	100.	410,104	100.

*Estimated on the basis of tonnage reported by the same establishments each year.

COMPARATIVE PRICES OF OHIO FARM PRODUCTS

J. I. FALCONER

Table 1 shows a comparison of prices of different Ohio farm products, both with each other and with prices of previous years. The commodities have been arranged in the table according to their relative price level during the year 1931. Chicken prices in 1931 were 42 per cent above the 1910 to 1914 level and were higher than any other product; chickens, therefore, come first in the table. It will be noted that in 1931 only five products sold at prices above the pre-war level; namely, chickens, potatoes, lambs, milk, and beef. Eleven products, on the other hand, sold at less than pre-war prices.

In February of 1932 only one product—namely, chickens—was higher in price than the 1910-1914 level. Eggs, on the other hand, were less than one-half the pre-war average price for February, while hay was only 39 per cent.

As a whole, during the years 1925-1929, Ohio farm products sold at prices 53 per cent above the pre-war level. In 1931, they were 11 per cent below, and, in February of 1932, they were 36 per cent below the pre-war average price.

TABLE 1.—Relative Prices of Ohio Farm Products

Item	Unit	Average price			Index of prices (1910-1914=100)			
		1910-14	1925-29	1931	1921-24	1925-29	1931	Feb. 1932
Chickens	Lb.	.12	.23	.17	175	196	142	124
Potatoes	Bu.	.77	1.43	.91	156	192	118	77
Lambs	Cwt.	6.05	11.96	6.50	166	210	108	84
Milk	Cwt.	1.55	2.61	1.63	159	169	105	90
Beef	Cwt.	6.02	8.64	6.25	110	146	104	77
Butter-fat	Lb.	.25	.44	.24	158	180	96	66
Milk cows	Head	53.00	82.00	50.00	114	159	94	81
Eggs	Doz.	.22	.34	.20	144	150	91	49
Corn	Bu.	.62	.87	.53	118	142	85	52
Hogs	Cwt.	7.62	10.77	6.40	108	145	84	52
Wool	Lb.	.22	.40	.18	171	190	82	76
Hay	Ton	14.20	11.64	11.50	93	84	81	39
Sheep	Cwt.	4.10	6.51	3.10	126	167	75	61
Oats	Bu.	.40	.45	.26	107	112	65	56
Wheat	Bu.	.96	1.40	.59	124	145	61	49
Horses	Head	163.60	108.00	95.00	64	66	58	55
All Ohio farm products					131	153	89	64

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

December of 1931 and January and February of 1932 saw still further price declines. At the last date, Ohio farm products averaged in price 36 per cent below the 1910-1914 level. Farm wages were down to the 1910 level. Industrial wages were also rapidly falling. Although the weekly earnings of New York State factory workers in January of 1932 were 91 per cent above those of 1914, the payroll total of New York State factories was only 42 per cent above the 1914 level.

For the United States as a whole the employment in manufacturing industries in January of 1932 was 65 per cent that of the year 1926; payrolls were 50 per cent of those of 1926. While wage rates may be the item influencing costs, total payrolls are a determining factor in purchasing ability.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913	102	....	100	100	104	100	105	100
1914	199	100	101	102	102	102	105	107
1915	102	101	106	100	103	107	106	110
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	141	232	156	139	169	96	154	147
1929	139	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	128	130
1931	107	....	129	80	120	82	89	93
1931								
January	114	212	137	94	133	....	106	115
February	112	215	136	90	....	....	98	85
March	111	219	134	91	....	82	100	104
April	109	215	133	91	119	....	103	97
May	107	211	130	86	....	....	98	90
June	105	207	129	80	....	....	93	93
July	105	207	128	79	115	....	86	86
August	105	207	127	75	....	....	87	90
September	104	205	124	72	....	....	82	87
October	103	199	123	68	116	....	77	86
November	102	196	123	71	....	....	79	93
December	100	194	123	66	....	....	72	88
1932								
January	98	191	121	63	100	....	69	81
February	....	....	....	60	....	72	64	68

SPECIAL DAYS FOR 1932

Feed Merchants' Day	Wednesday, May 4
Livestock Marketing Men's Day	Thursday, May 5
Livestock Day	Friday, May 6
Poultry Day	Friday, June 17
Forestry Day	Friday, June 24
Wheat and Clover Day	Thursday, June 30
Dairy Day	Friday, August 12
Orchard Day	Friday, August 19
Corn and Soybean Day	Date to be announced later

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 498. A Market Analysis of Farm Sales of Milk to Dealers in Four Ohio Cities, by R. W. Sherman and C. G. McBride. This study deals with the relation of market practices to the butterfat content of the milk purchased by dealers and with some of the other market factors that have an influence upon the character of the supply.

Bulletin 499. Growing of Greenhouse Tomatoes, by I. C. Hoffman. This bulletin reports studies of the best time of sowing seed, the effect of holding tomato plants in pots, distance of planting, leaf pruning, mulching, fertilizing during the fruiting period, and potted versus trowel-set plants.

Bulletin 500. Spraying Program and Pest Control in the Orchard. This bulletin discusses the standard spray materials now offered for sale and suggests proper combinations that will control both insects and diseases without causing spray injury to the fruit and foliage.

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

THE DEVELOPMENT OF RAYON[1]

MARION GRIFFITH AND GLADYS SCOTT COOK

EARLY DEVELOPMENT OF RAYON

Today rayon is playing its part, and an important one, in practically every fabric known to the knit-wear trade, as well as occupying an important place in woven fabrics, ranging from the simplest wash materials to the most costly and style-important materials, such as transparent velvets, satins, and lamés.

The invention and early development of rayon took place in Europe. For many years, in fact until 1913, rayon was strictly a foreign product. The invention of the first man-made fiber was the result of an attempt to imitate silk. The earliest attempts were made in 1754 when Reaumur, a French scientist, pointed out the possibility of producing artificial fibers, using the method employed by the silkworms and spiders; namely, drawing out or spinning from a solution. He believed that some of the hard, lustrous, waterproof varnishes might be used, but none of his attempts were successful. From that time until 1884 scientists of many countries made attempts to produce a synthetic fiber, but all efforts proved fruitless.

Count Chardonnet, a French scientist, inventor of the first commercially successful synthetic yarn, reasoned that by using mulberry leaves (upon which the silkworm feeds) he should be able to produce the same chemical changes which take place in the body of the silkworm and produce a filament like silk. He studied not only the leaves but also the tree and, in 1884, took out a patent for an artificial fiber made with a cellulose base obtained from the mulberry tree. He also patented machinery for making the filament. This first artificial fiber to be extensively used was exceedingly shiny, harsh to the touch, and extremely inflammable.

Other means of manufacturing the artificial fiber were discovered and proved successful. The new textile was introduced into America in 1910 principally as a decorative element in fabrics, forming dots or other patterns, which dissolved when the garment became wet. In 1912, this artificial fiber began to be used in hosiery. The fiber, then still called artificial silk, had been greatly improved, but there were many pairs of hosiery made of this fiber which dissolved on the feet of the wearer as the fiber came in con-

[1]Because of general interest in the subject, this article is included even though it contains no experimental data. A bibliography may be obtained upon request from the authors, Department of Home Economics, Ohio Agricultural Experiment Station, Columbus, Ohio.

tact with perspiration. Still greater trouble came in washing hosiery, underwear, and other knitted and woven garments made of synthetic fibers. In the early days of artificial silk, it was not wise for a woman to wear a dress or outer garment of this material if she was likely to be caught in a shower. The slipperiness of the thread, the smoothness of its surface, and the extreme springiness of the fiber made artificial silk difficult to manipulate in either weaving or knitting. This difficulty has been largely overcome.

In 1913 the first American rayon plant was put in operation. Since that time the rayon industry has enjoyed phenomenal growth. Today, in the United States there are a number of large rayon manufacturing plants. In 1920, the United States produced 9,000,000 pounds of rayon; the world production was 50,000,000 pounds, at a cost of about 4 dollars a pound. In 1931, the manufacturers of the United States produced 144,350,000 pounds and the total world production was 467,505,000 pounds. The cost today is about one dollar a pound.

One authority predicts a world consumption of rayon in 1940 surpassing the combined consumption of wool and cotton. This somewhat startling prophecy is based on the rate of growth over the past 25 years. The beauty, adaptability, and wearing qualities of rayon have already placed it third in importance as a modern textile fiber.

Rayon is a distinct textile fiber, known to chemists as regenerated cellulose or, in one case, as cellulose acetate. Although rayon looks like silk, it is emphatically not silk, nor an imitation thereof. They are entirely different, both chemically and physically, although both are long, lustrous filaments. In the early days of the industry in America, rayon was called "artificial silk". In recent years, however, its individuality has been recognized, and the name "rayon" was coined to replace the old term.

Rayon, at its best, is a superior fiber which man has made to meet his requirements. It is the only fiber of commercial value which has been achieved by the inventive brain of man. The natural fibers—wool, silk, cotton, and linen—must be used much as nature creates them and the cloth made according to inherent characteristics; whereas rayon may be made according to the requirements of the cloth.

THE MANUFACTURE OF RAYON

The following definition of rayon has been adopted by rayon groups of the Committee of Textiles of the American Society for Testing Materials: "Rayon—The generic name of filaments made

from various solutions of modified cellulose by pressing or drawing cellulose solution through an orifice, and solidifying it in the form of a filament or filaments, by means of some precipitation" .

The solution of modified cellulose is obtained commercially either from cotton linters (the short ends of cotton which cling to the cotton seeds after the long cotton fibers have been removed) or from wood pulp (usually northern spruce). The precipitating or coagulating media most commonly used are air, acids, salts, alkalis, and water. The nozzles or spinnerets containing orifices are made of platinum, monel metal, or glass.

Two general classes of rayon are being manufactured, regenerated cellulose and cellulose acetate. There are four basic, chemical methods or processes used commercially in making rayon, each producing a product somewhat different from the others. They are given in the order in which they were invented:

1. Denitrated cellulose-nitrate or Chardonnet.
2. Cuprammonium.
3. Cellulose acetate.
4. Viscose.

METHOD OF MANUFACTURING CHARDONNET

In this process, cellulose (cotton linters) is nitrated with a mixture of nitric and sulfuric acids. The acid is removed by washing, and the material dissolved in a suitable solvent, generally a mixture of alcohol and ether. It is then forced through fine orifices and coagulated either in air or in water. These fabrics, after thorough washing, are passed through a solution of an alkali sulfide which denitrates them and makes them less inflammable.

METHOD OF MANUFACTURING CUPRAMMONIUM

This process is based on the solubility of cellulose (cotton linters) in copper hydroxide and ammonia. The solution thus formed is forced through the spinneret and coagulated in a bath of sulfuric acid and water or a caustic soda solution. In this process most of the ammonia and copper is recovered.

METHOD OF MANUFACTURING CELLULOSE ACETATE

Cellulose acetate is not a regenerated cellulose as are the other three types, but the cellulose is chemically changed into an ester of cellulose, forming a substance known as cellulose acetate. Yarns made this way have characteristics definitely unlike other synthetic yarns.

This process consists in acetylating cellulose (usually cotton linters, but in some cases wood pulp), forming the acetate, with a mixture of acetic acid and acetic anhydride in the presence of a catalyst. The catalysts commonly used are sulfuric acid or a zinc salt. The cellulose thus formed is then dissolved in a suitable solvent (for example, acetic acid) and discharged through a fine nozzle into a non-solvent coagulating bath, such as water.

METHOD OF MANUFACTURING VISCOSE

The largest per cent of the yarns is made by this method. Approximately 85 per cent of the synthetic yarn produced in this country is made by the viscose method.

The cellulose (wood pulp, northern spruce wood containing small amounts of resin and other gum substances) is first treated with caustic. Part of this caustic is removed by pressing. The material is then treated with carbon bisulfide and, in turn, dissolved in water. This solution after proper maturing is put through the regular spinning operation by forcing the cellulose through fine orifices into an acid or acid-salt fixing bath to form the fiber.

RECENT DEVELOPMENTS IN THE MANUFACTURE OF RAYON

The foremost producers of synthetic yarns have done much to standardize qualities of rayon yarns.

The Viscose Quality Control Plan is the result of one effort to improve yarns. This organization, collaborating with the Better Fabrics Testing Bureau, made specifications which adhere to the size specifications recently set up in the industry under the auspices of the United States Bureau of Standards. If garment manufacturers lower the standard of their products their licenses are revoked.

Newer developments include new, low-lustered yarns, increasingly fine deniers, wrinkle-proof fabrics, new colors, new finishes, and, probably most remarkable of all, a new viscose process of yarns that is even stronger than silk and not materially affected by moisture. The cost of manufacture is still too high for general use.

Because of the natural weight of the rayon fiber, rayon crepes and crepes in which rayon and silk are intermixed are rarely weighted. It is customary, however, to add certain finishing materials during, or subsequent to, the dyeing operation in an amount varying from 0.5 to 3 per cent. Rayon weighting today essentially consists of an addition of a finishing agent to the knitted cloth before it is sold to the cutter or garment manufacturer, in an amount varying from 5 to as high as 16 per cent of the weight of the cloth. Various weighting agents are used, one of the most popular being magnesium sulphate or common epsom salts. Barium salts and ordinary water also have been used to weight the fabric.

The fabric is dipped in an aqueous solution of magnesium sulfate. The magnesium sulfate clings to the fabric as a fine powder which diffuses the light, giving a delustered effect and a full heavy "hand". In washing, the soluble weighting dissolves, leaving a thin fabric of poor construction. The real danger comes when the weighted garment remains on the retailer's shelf too long, becoming rancid and tender.

The manufacturers of rayon cloth at a meeting of the National Retailing Dry Goods Association made the following resolution: "Be it resolved, that the undersigned manufacturers of synthetic textile yarns and retail merchants of textiles do hereby protest against the adulteration of rayon merchandise detrimentally affecting its serviceability and durability, or resulting in deception to the consuming public."

MILK IN THE DIETS OF YOUNG CHILDREN

HUGHINA McKAY

The pre-school period, from 18 months to 5 years, is a very important one from the standpoint of the development of sound food habits in children. During these years the foundation for robust health for the future may be laid. During the pre-school years the aim in feeding children is not only to provide adequately for their needs in this period of rapid growth but to do this in such a way that the digestive apparatus develops normally and that good food habits are established.

Experimental work in feeding animals, as well as children, has shown that milk occupies a place of unique importance in the diet of the growing young. No other food can take its place completely, because no other food reinforces the diet at so many places. During the early months of the first year of life, milk is the principal food of the infant and provides practically all the calories, as well as the other nutrients, needed. As the child becomes older, other foods are added, but milk should continue to form the basis of the diet throughout the entire period of childhood.

Proteins of milk are of excellent quality, are relatively inexpensive, are easily digested, and are well absorbed. Milk proteins supplement the less expensive proteins of the cereal products and so make possible inexpensive, adequate protein provision for children. Milk not only leads all other foods as a source of calcium, but its calcium is utilized to better advantage than is that of fruits and vegetables. Much of the phosphorus needed in the diet may also be obtained from milk, and, although milk is considered a poor source of iron and must be reinforced in this respect, the iron of milk is extremely well utilized. As a source of vitamin A, the value of whole milk is recognized. Vitamins B and G are also present, but such small amounts of vitamins C and D are found in milk that their addition to the diet has become a routine procedure in child feeding.

Relatively few studies have been made of the foods used by individual children, especially of children of pre-school age.

In connection with a study of the food habits and physical development of a group of pre-school children in Columbus, Ohio, the amounts and kinds of food used by each child in the group were determined for one week during January and again for one week during the latter part of March.

Milk was used by all the children, but in varying amounts. During January, the group averaged 2.3 cups per day, with the amounts used by individual children ranging from 1.4 to 3.0 cups daily. These amounts included milk which was used in food preparation, as well as milk used as a beverage. Although these amounts were all less than the desirable standard of one quart of milk a day, the important contribution which the amounts used made to the diets of the children is worth noting. When the nutritive value of the foods used by each child for the 7-day period in January was computed, it was found that the milk used provided 31 per cent of the total calories, almost half of the protein, 80 per cent of the calcium, 59 per cent of the phosphorus, and approximately one-fifth of the iron, in addition to the contribution of the milk to the vitamin value of the diet.

When the foods used during March by the same group of children were studied, it was found that every child was using more milk than the amount he had used during January, the average increases ranging from 12 to 45 per cent per child for the 7-day period. The average amount used by the group had increased from 2.3 cups to 2.7 cups per child per day, with the amounts used daily ranging from 1.8 cups to 3.5 cups per child. During this period, milk provided an average of 37 per cent of the total calories, 52 per cent of the protein, 84 per cent of the calcium, 62 per cent of the phosphorus, and 21 per cent of the iron, as well as contributing to the vitamin content of the diet.

The increased use of milk in March over that used by the group in January is encouraging and illustrates the fact that children's food habits may be improved with little difficulty and that a custom may be established by repetition. The increase in the amount of milk used was brought about, in part, by a larger use of milk as a beverage and, in part, by a larger use of milk in food preparation. As far as the utilization of milk in the body is concerned, one method is probably as satisfactory as another. From the standpoint of establishing the habit of using a desirable food, the habit of using milk as a beverage is more desirable and constitutes an important "factor of safety" in the diet. Perhaps one of the most effective methods of establishing this very desirable milk-drinking habit in children is for adults to set the good example of using milk as a beverage.

In a recently published study of the foods used by a group of pre-school children in New York City, Rose and her co-workers[1] report that the calories derived from milk in the diets studied ranged from 30 to 50 per cent of the total calories, and they suggest as desirable a standard of from 45 to 55 per cent. The authors state that, unless these amounts of milk are used, foods less valuable from the standpoint of growth-promoting substances are likely to make up too large a proportion of the diet.

[1]Rose, Mary A., Robb, Elda, and Borgeson, Gertrude M. The food consumption of nursery school children. Child Development III: No. 1, 1932.

CALLA LILY ROOT ROT AND ITS CONTROL

PAUL E. TILFORD

A root rot disease of calla lilies has become prevalent in Ohio and has caused considerable loss to some florists. This disease did not occur in Ohio until fairly recently and should not be confused with soft rot which has been present for many years.

The plants affected with root rot appear normal for a time; then the outer leaves begin to yellow along the margins, and gradually the entire leaves yellow and droop. Other leaves are affected progressively inward, but new leaves may continue to develop. If the plants flower at all, the tip of the blossom turns brown and does not open up properly.

Fig. 1.—Phytophthora root rot of Calla Lily. All three plants grown from corms affected with the disease. Plant on left grown from corm treated in corrosive sublimate solution and planted in new soil. Plant in center grown from untreated corm but planted in new soil. Plant on right grown from treated corm planted in soil contaminated with the root-rot fungus.

When the roots of these plants are examined, the source of the trouble is seen. The feeder roots start rotting at the tips and the rot progresses backward to the corms, Figure 1. The infected roots

have a water-soaked appearance, and all that finally remains of them is the epidermis which appears as a hollow tube. New roots are sent out from the corm, and these, in turn, rot.

Sometimes the corm is attacked but usually not extensively. The rot in the corm is more or less dry and spongy and never wet and slimy as in soft rot.

Root rot is caused by a fungus known as *Phytophthora richardia* Buisman. The fungus may live over from one crop of callas to the next on the corms or in the soil. Figure 1.

An extensive set of experiments has been conducted at the Experiment Station to determine the best treatment to sterilize the corms before planting. Two lots of corms were selected from diseased plants in 1930. One lot consisted of very small corms which were separated into four groups. One set was treated for 2 hours in a corrosive sublimate solution made by dissolving 1 ounce of corrosive sublimate in 7½ gallons of water. A second set was treated for 1 hour in a 2 per cent formaldehyde solution (1 part of formaldehyde to 49 parts of water). The third set was treated for 1 hour in a 0.25 per cent Semesan solution, and the fourth set was left untreated for a check.

These corms were planted in 6-inch pots on August 4, three corms to each pot, and were grown through the winter in the greenhouse. On April 25, 1931, the plants were taken from the pots and examined for root rot. The results are given in Table 1. Flowering data were not obtained, since the corms were too small to flower satisfactorily.

TABLE 1.—Control of Calla Lily Root Rot

Treatment	No. of pots	Per cent free of root rot	Per cent slightly affected	Per cent severely affected
Check, no treatment	17	5.9	35.3	58.8
Semesan, 1 hour, 0.25 per cent solution	19	31.6	42.1	26.3
Formaldehyde, 1 hour, 2 per cent solution	16	75.0	25.0	0.0
Corrosive sublimate, 2 hours, 1 oz. to 7½ gal.	17	94.1	5.9	0.0

In the second lot, the corms were large and most of them were affected with soft rot in the tops making it necessary to cut out the crowns. For this reason, satisfactory blooming records could not be obtained on this set. These corms were planted one to a 6-inch pot. The treatments and results obtained are given in Table 2.

TABLE 2.—Control of Calla Lily Root Rot

Treatment	No. of plants	Per cent free of root rot	Per cent slightly affected	Per cent severely affected
Check, no treatment	10	0.0	10.0	90.0
Semesan, 1 hour, 0.25 per cent solution	20	60.0	30.0	10.0
Formaldehyde, 1 hour, 2 per cent solution	22	77.4	22.7	0.0
Corrosive sublimate, 1 hour, 1 oz. to 7½ gal.	22	72.7	22.7	4.5

All three of the materials used for treating the corms greatly reduced the amount of root rot, but in both sets of experiments formaldehyde and corrosive sublimate were more efficacious than Semesan. In one set, formaldehyde was superior to corrosive sublimate and, in the other set, just the opposite was the case. Both materials are considered of about equal value. Formaldehyde is a little easier to use than corrosive sublimate.

The treated corms start growing slower than untreated ones, and because of this it is advisable to plant about 2 weeks earlier than would be necessary otherwise.

It is better to grow the callas in pots rather than in benches if root rot is present. When the disease starts in a bench, it spreads through the soil and may infect all the plants; whereas if pot culture is practiced and a few plants become diseased, they can be removed.

The pots should be sterilized before the corms are planted, especially if diseased callas were grown in them the year previous. This can be done by immersing the pots in one of the disinfecting solutions mentioned above for 30 minutes.

TIMELY HINTS ON WHEAT SEEDING AND SEEDBED PREPARATION

L. E. THATCHER

The low price for wheat may have a tendency to bring about a neglect of some cultural practices which contribute to increased yield per acre. Such neglect will make a bad situation worse. Many of these practices require no additional cash expense but only careful attention to such details as preparing the seedbed, sowing the right amount of seed at the proper time, and using good disease-free seed of high-yielding varieties.

Preparing the seedbed.—An 8-year test at Wooster shows a difference in yield of 4.7 bushels per acre between the best and poorest method of preparing an oat stubble for winter wheat. Table 1 gives the data obtained.

TABLE 1.—Preparation of Seedbed for Wheat, Wooster

Oats stubble	Yield per acre 8-year average		Test weight per bu.
Date of preparation*	Grain	Straw	
	Bu.	*Lb.*	*Lb.*
Plowed August 15	40.1	4262	59.4
Plowed September 1	38.8	3929	59.3
Plowed September 15	36.8	3698	59.3
Disked early, August 1 to 15 / Plowed September 1	38.2	4046	59.3
Disked early, August 1 to 15 / Plowed September 15	37.8	3903	58.9
Disked only on three dates, Aug. 1, Sept. 1, and Sept. 15	35.4	3666	59.1

*Dates varied 2 or 3 days from those given, due to weather, etc. Wheat was sown at approximately September 25 each year, at which time the final preparation of the seedbed was made, all plots being treated alike at that time.

The results for the individual years have been fairly consistent with the average results; an exception was obtained in 1931 as noted below. Early plowing has been better than late plowing. Disking, as a supplementary treatment, has not paid. Disking alone has been the least profitable method of seedbed preparation. The soil used in this test is Wooster silt loam.

A number of similar tests, carried out at other experiment stations in the United States covering a wide range of soil types and climatic conditions, indicates a rather universal response for early seedbed preparation.

Early seedbed preparation is conducive to a favorable moisture supply in the soil and to nitrate-nitrogen accumulation, both of which are important factors in obtaining a good fall growth of wheat. There may be other favorable factors involved which are not as well understood. The mechanical and physical condition of the soil itself may be a factor influencing root growth.

After small grain harvest, in normal seasons, the stubble land is soon occupied by weeds (sometimes mixed with clovers) whose growth throughout the summer draws heavily upon the moisture and nitrate supply in the soil. Then, if the land is plowed late, these elements are likely to be less than optimum for the best growth of the wheat crop. In Ohio, nitrates are likely to be the limiting factor, rather than moisture.

The season of 1930 at Wooster was abnormal, due to the drouth. The soil after oat harvest was very loose, so loose that it could be stirred easily with the foot. Nitrate-nitrogen was very high at that time because no rains had occurred sufficient to cause leaching. The continued dry weather prevented the growth of weeds so that the nitrate supply remained abundant throughout the season; consequently, there was little difference in the yields of wheat in the harvest of 1931 as a result of different methods of seedbed preparation in 1930.

The early plowing of sod land going into wheat is also desirable in order to insure a proper moisture content of the soil and to allow time for the decay of the sod to get well under way. The early stages of decay of organic matter are likely to be accompanied by a temporary shortage of soil nitrates, the degree depending somewhat upon the composition of the organic matter itself.

The rate and date of sowing.—That there is a best date and a best rate for sowing wheat has been demonstrated in experiments of several years' duration at Wooster. These experiments, carried on independently, have shown that at Wooster the period of September 20-25 is the best date for sowing, based on a 16-year average, and 8 pecks per acre the best rate, based on a 28-year average. Rates on 6 and 10 pecks resulted in less than a bushel lower in net yield (seed used deducted from the crop harvested). These independent tests did not indicate whether the rate should be changed as the date varied. Perhaps, very late seedings should be made at a heavier rate. In order to answer this question, a combined rate- and date-of-seeding test has been carried on and the results are given in Table 2.

It is to be noted that during normal seasons September 25 has been the best date of seeding, as shown by the yields of grain and straw and quality of grain, and 10 pecks of seed per acre have a slight lead over 6 and 8 pecks. There are two noticeable exceptions, however—1920, a Hessian fly year, and 1928, a year of much winterkilling. October 15 was the best date during the Hessian fly year and there was some indication that 10 pecks were better than 6, with one exception, October 15, when 6 pecks gave the highest yield. However, that figure may be an error. The 1928 crop, following the severe cold snap in the fall and early winter, was highest from the September 25 seeding, at which time there was little difference between the rates. Wheat seeded on the next date, October 5, however, was badly winterkilled, and the 10-peck rate was far ahead of the 8-peck and the 8 ahead of the 6-peck rate in yield.

TABLE 2.—Combined Rate and Date of Sowing Wheat Test, Wooster

Number of years tested and rate of sowing	Grain							Straw							Test weight per bushel						
	Date of sowing							Date of sowing													
	September			October			Av.	September			October			Av.	September			October			Av.
	6	16	25	5	15	25		6	16	25	5	15	25		6	16	25	5	15	25	
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Eight years*																					
6 pecks	34.2	35.4	40.7	38.5	33.5	25.9	34.7	3855	3930	4050	3542	3159	2586	3520	58.7	59.1	59.7	59.3	58.8	56.7	58.8
8 pecks	32.9	36.4	41.3	38.2	32.7	26.8	34.7	3525	3881	4112	3691	3026	2855	3515	58.8	59.6	59.6	59.1	59.0	57.2	58.9
10 pecks	34.6	38.5	41.6	38.8	34.7	28.5	36.1	3696	4021	4141	3842	3281	2692	3612	58.9	59.6	59.6	59.1	59.0	57.9	59.0
Average	33.9	36.8	41.2	38.5	35.0	27.1	.....	3692	3944	4101	3692	3155	2711	.....	58.8	59.4	59.6	59.2	58.9	57.3	.....
Twelve years*																					
6 pecks	.....	36.1	41.4	38.3	34.3	26.2	35.3	.....	3852	3829	3492	3193	2714	3416	.....	59.6	59.9	59.5	59.1	57.5	59.1
8 pecks	.....	36.5	41.9	38.8	33.6	27.7	35.7	.....	3714	3951	3697	3189	2926	3495	.....	59.8	59.8	59.5	59.1	57.1	59.1
10 pecks	.....	38.9	42.3	39.1	35.9	29.2	37.1	.....	3916	4012	3792	3361	2868	3594	.....	60.0	59.6	59.4	59.3	58.3	59.3
Average	.....	37.2	41.9	38.7	34.6	27.7	.....	.....	3827	3931	3660	3248	2843	.....	.....	59.8	59.8	59.5	59.2	57.6	.....
1920 only†																					
6 pecks	.....	1.3	16.7	16.7	30.9	12.5	15.6	.....	No straw yields obtained this year						.....	.....	.....	.....	.....	.....	.....
8 pecks	.....	3.4	21.3	27.9	24.6	16.2	18.7	.....							.....	.....	.....	.....	.....	.....	.....
10 pecks	.....	6.9	22.2	23.5	24.3	15.7	18.5	.....							.....	.....	.....	.....	.....	.....	.....
Average	.....	3.9	20.1	22.7	26.6	14.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1928 only‡																					
6 pecks	21.3	32.2	38.0	6.8	No crop—all winter-killed		24.6	3680	2630	3360	3390	No crop—all winter-killed		3265	56.5	59.3	59.6	57.4	No crop—all winter-killed		58.2
8 pecks	33.0	33.2	39.7	15.2			30.3	2980	2770	3340	2890			3017	58.7	59.5	57.6	54.9			57.7
10 pecks	34.7	34.0	39.7	25.7			33.5	2960	2960	3020	2660			2900	56.7	59.1	57.7	58.6			58.0
Average	29.7	33.1	39.1	15.9	.....	.....	.....	3207	2787	3240	2980	.....	.....	.....	57.3	59.3	58.0	57.0	.....	.....	.....

*Normal years—no serious Hessian fly or winterkilling—1920 and 1928 omitted.
†Hessian fly year—Note low yields for early dates.
‡Winterkilling year—Note low yields for late dates.

To date, this test shows that, at Wooster, there is little need for varying the rate of seeding wheat when sown on different dates. Eight to 10 pecks per acre cover the range pretty well. If sown very late or in situations where the wheat frequently winterkills badly, the 10-peck rate may be somewhat safer than less seed.

Tests over the State on the outlying experimental farms show that the optimum date for seeding wheat varies somewhat with latitude and with the climatic and soil conditions. Fortunately, these dates correspond fairly well with the dates of seeding recommended by our entomologists in the control of Hessian fly injury. These range from September 22 in northern Ohio to October 5 in southern Ohio. On the heavy soil types in the northeastern corner of the State, however, in the absence of Hessian fly, earlier seeding than September 22 is generally necessary to get good stands that winter well. September 10 to 15 has been a favorable time on the Trumbull County and Mahoning County Experiment Farms.

Should some varieties be sown thinner than others?—Twenty-one varieties and strains of wheat were used in the 28-year rate-of-seeding test at Wooster, two varieties frequently being grown the same year. In no complete test did less than 6 pecks per acre give a maximum yield for any one variety. The range of desirable rates was from 6 to 10 pecks, with 8 pecks generally satisfactory. Some of the varieties that have weak straw and tiller profusely did best at the 6-peck rate on rich land.

Trumbull and Fulhio, two of the most popular Ohio varieties at the present time, have been compared at Wooster in a rate-of-seeding test for 7 years, both varieties being grown each year. The yields are given in Table 3.

TABLE 3.—Comparison of Trumbull and Fulhio—Rate-of-Seeding Test
7-year average

Yields net (Seed used deducted from crop harvested)

Seed per acre, pecks ☞	4	6	8	10
	Bu.	*Bu.*	*Bu.*	*Bu.*
Trumbull	31.1	35.6	37.3	37.4
Fulhio	33.1	36.6	36.4	36.0

Fulhio is a more prolific tillering variety than Trumbull, and, on this land, which is maintained at a fairly high level of productivity, 6 pecks of seed per acre have been sufficient for a maximum yield. On rich land, Fulhio may lodge at the heavier rates. Trumbull does not tiller as much as Fulhio, has a stiffer straw, and 8 to 10 pecks were the best rates of seeding.

In general, the rate of seeding a variety may be adjusted as follows: Weak strawed varieties on rich land should be sown at about 6 pecks per acre. If sown late in the fall or on land of medium fertility, sow about 8 pecks. Stiff strawed varieties may be sown at 8 to 10 pecks at all times, the thinner rate on very rich land.

Wheat may be sown at the thinner rate, 5 to 6 pecks per acre, when used as a nurse crop for alfalfa.

CHOOSING YOUR VARIETY OF WINTER WHEAT

C. A. LAMB

"How can I produce a bushel of wheat at less cost?" is a question that many Ohio farmers will ask themselves when they are considering the 1933 crop. There are only two ways to accomplish this: first, by decreasing the cost of growing each acre without a corresponding decrease in yield; or, second, by increasing the yield from each acre without increasing costs in proportion. To get the best results, the variety must be adapted to soil and climate, seed must be of good quality, and good cultural practice must be followed.

Choice of variety is the one factor at the command of the grower which costs nothing but a little trouble. Fortunately, the farmer has information upon which to base a selection in the results of the wheat variety tests at the Experiment Station at Wooster, the University Farm at Columbus, and 13 County and Test Farms widely distributed over the State. The summary of these tests is presented in Tables 1, 2, and 3 and will merit some careful study.

For practically all localities in Ohio, the choice of variety narrows down to Trumbull, Fulhio, Nabob, or Gladden. Trumbull and Fulhio together make up approximately three-fourths of the Ohio winter wheat crop. In general, Fulhio would appear to outyield Trumbull in nearly all areas and is slightly more winter hardy. In the northeastern quarter of the State, however, Trumbull seems to have some advantage on the heavy soils and, possibly, also on the more acid soils that have not been adequately limed. Undoubtedly, these two varieties should be considered the standard varieties, and, in most cases, the choice will rest between the two.

A study of the tables, however, shows that in several localities Nabob or Gladden has distinctly outyielded Trumbull or Fulhio. This is true for Nabob in northeastern Ohio, where heavy soils are

TABLE 1.—Wheat Variety Test, Wooster

All yields corrected to Trumbull

Variety	Bushels per acre	Years tested	Bearded	Strength of straw	Color of chaff	General remarks
Standard red varieties suitable for Ohio						
Fulhio	39.2	16	No	Fair	White	Good general milling variety.
Nabob	38.1	9	Yes	Fair	White	Hardy; weak strength flour.
Gladden	38.0	23	Yes	Stiff	White	Hardy: weak strength flour.
Trumbull	37.0	23	No	Stiff	White	Good general milling variety.
Nigger	36.4	32	Yes	Weak	White	Should be replaced by Nabob.
Poole	35.9	32	No	Weak	Red	Being replaced by better varieties.
Fultz	34.7	32	No	Stiff	White	Good general milling variety.
Red varieties not recommended for Ohio for various reasons						
Red Rock	39.6	14	Yes	Fair	White	Hardy: good milling wheat.
Ohio 9920	38.7	16	No	Stiff	Red	Hardy; smut susceptible.
Portage	38.6	21	No	Weak	Red	Non-hardy: smut susceptible.
Nittany	38.0	11	Yes	Fair	White	Inclined to lodge on strong land.
Red Wave	37.9	24	No	Fair	Red	Poor milling wheat.
Harvest King	37.7	30	No	Weak	Red	Similar to Poole.
Forward	37.2	10	No	Stiff	White	
Purkof	37.0	6	No	Stiff	White	Poor milling wheat.
Valley	36.7	29	Yes	Weak	White	Hardy; weak strength flour.
Rudy	36.0	28	Yes	Fair	White	Satisfactory milling wheat.
Mealy	35.8	32	No	Fair	White	Poor milling wheat.
Gipsy	35.6	32	Yes	Weak	White	
Fultzo-Mediterranean	35.4	30	No	Stiff	White	Shatters easily.
Early Ripe	34.9	32	No	Fair	Red	Similar to Red May.
Berkeley Rock	34.9	5	Yes	Fair	White	Poor milling wheat.
Goens	34.7	19	Yes	Fair	Red	Susceptible to smut.
Fulcaster	34.6	32	Yes	Fair	White	Good milling quality.
Mediterranean	34.4	32	Yes	Weak	Red	Early maturing; shatters easily.
Leap	34.3	10	No	Fair	White	Not very hardy.
Baldwin	34.2	7	Yes	Weak	White	Local variety: Madison and Union Counties.
Miracle	33.9	19	Yes	Weak	Red	Similar to Fulcaster.
Kharkov	32.2	21	Yes	Fair	White	Hardy; not a soft red winter wheat.
Michikof	32.1	8	No	Stiff	White	Low quality, poor milling wheat.
Velvet Chaff	31.9	31	Yes	Weak	Red	Inferior old-time variety.
Kanred	31.9	12	Yes	Weak	White	Hardy; not a soft red winter wheat.
Turkey Red	30.7	32	Yes	Weak	White	Hardy; not a soft red winter wheat.

TABLE 1.—Wheat Variety Test, Wooster—Continued

All yields corrected to Trumbull

Variety	Bushels per acre	Years tested	Bearded	Strength of straw	Color of chaff	General remarks
		White varieties				
Dawson's Golden Chaff	39.1	32	No	Stiff	White	Flour strength variable.
Klondike	39.1	22	No	Stiff	White	Flour strength less variable than Dawson.
No. 6 Junior	38.3	10	No	Stiff	White	Flour strength similar to Gold Coin.
Gold Coin	37.1	31	No	Stiff	White	Flour strength less variable than Dawson.
O. A. C. 104	36.0	4	No	Stiff	White	Flour strength variable.
		New Ohio selections and hybrids				
T. N. 1016 Hybrid	42.9	3	No	Stiff	Red	Portage x Fulcaster.
T. N. 1006 Hybrid	41.1	6	No	Stiff	Red	Portage x Fulcaster.
T. N. 1029 Hybrid	41.0	6	No	Fair	White	Gladden x Trumbull.
T. N. 1047 Hybrid	39.3	3	No	Stiff	Red	Portage x Gladden.
T. N. 1043 Hybrid	39.0	3	No	Fair	Red	Portage x Gladden.
T. N. 1036 Hybrid	38.7	3	No	Stiff	White	Velvet Gipsy x Gladden.
T. N. 1033 Hybrid	37.7	3	No	Fair	White	Gladden x Trumbull.
O. S. U. 139-10 Hybrid	37.7	3	No	Fair	White	Portage x Fulcaster; hardy.
T. N. 1034 Hybrid	37.2	2	No	Stiff	Red	Velvet Gipsy x Gladden.
O. S. U. 15174 Selection	35.2	8	Yes	Fair	White	Hardy.

encountered; whereas Gladden is outstanding at a number of farms in the west central and southwestern areas of the State. There are disadvantages to these varieties, however, which may or may not be considered serious by the individual grower. Both are bearded and, consequently, not so easy to handle in the field and at threshing time. Nabob tends to be somewhat variable in quality, apparently being very sensitive to soil and seasonal variations, but, on the whole, it has proven a fairly satisfactory milling wheat.

Gladden is late in maturing, and the appearance of the grain is not good due to the small, rather poor appearing kernels. It is, however, satisfactory to the miller and is much less variable in quality than Nabob. In addition, Gladden is distinctly the most winter hardy of the four varieties mentioned.

TABLE 2.—Wheat Variety Test, Columbus

Variety	Actual yields per acre		
	8-yr. average 1921-1927	8-yr. average 1923-1931	3-yr. average 1929-1931
	Bu.	*Bu.*	*Bu.*
Nabob	....	....	41.6
Gladden	29.3	32.9	40.9
Fulhio	....	33.6	37.7
Ohio 15174	27.8	32.4	37.3
Trumbull	26.2	30.5	36.3
Turkey Red	30.7	28.7	34.4
Gipsy	28.1	....	....
Dawson's	28.0	....	....
Fulcaster	28.1	....	....
Fultz	26.2	....	....
Nigger	26.2	....	....
Mediterranean	25.7	....	....

Due to their greater resistance to winter injury, there is some temptation to grow hard red winter varieties, such as Turkey Red or Kharkov. However, on the average, these varieties do not yield as well as the standard Ohio sorts. Any considerable amount of these wheats mixed in the Ohio crop would seriously lower its value to the miller and would probably be reflected in reduced prices. White wheat mixtures with the red winters are also undesirable from the buyer's point of view and should not be grown unless storage facilities are such that the grades can be kept separately.

The Experiment Station has for many years carried on an extensive wheat improvement program. The fact that all four varieties recommended for special consideration above were developed by the institution proves the value of the work. Today, a number of new lines produced at Wooster and Columbus have reached the stage where they are being tested on the outlying farms. Some of these, as may be noted in Tables 1 and 3, are quite

TABLE 3.—Variety Wheat—Winter Wheat on Outlying Farms

Yield per acre corrected to average yield of Trumbull in all cases

	Variety	Paulding		Miami		Madison		Montgomery-S.W.Exp.		Hamilton		Clermont	
		Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested
Wooster Selections and Parent Varieties	Trumbull	29.7	17	31.0	18	30.7	12	28.4	21	33.9	6	20.1	16
	Fultz			30.3	14			27.8	23				
	Fulhio	30.6	6	33.8	7	34.0	7	27.7	13	38.8	14	21.6	7
	Nigger	26.5	12	30.4	12	28.5	7	28.6	20	33.6	7	28.7	8
	Nabob	30.2	5	31.4	4	32.2	5	29.7	5	36.2	3	22.5	6
	Gipsy			32.5	14			28.6	20				
	Gladden	29.8	17	34.2	16	32.5	10	27.8	17	38.7	15	24.5	16
	Poole			30.3	16	29.6	4	27.8	21			20.5	5
	Portage	26.8	10	30.2	12			28.8	15	37.7	11	23.4	11
	Ohio 9920	31.5	4	31.0	11	31.5	7	29.4	10	37.8	13	24.8	3
	Ohio 14085			32.4	3			30.4	4	36.1	4		
Standard Varieties	Dawson							29.0	21				
	Fulcaster							27.3	17				
	Mediterranean	23.3	7	30.3	10			26.6	20	37.0	12	22.9	15
	Valley			31.5	14			27.0	20	36.5	4		
	Goens	20.8	8	29.5	14			28.1	3	36.3	14		
	Velvet Chaff	25.8	11	28.1	12	28.2	6	25.6	19	34.1	11	24.4	11
	Rudy	27.8	11	31.0	14			27.5	18			23.7	11
	Turkey Red	29.7	9	26.8	10			23.7	14	36.1	7	18.2	6
	Kharkov	30.1	9					25.6	16	31.9	2	17.0	3
	Kanred			34.0	5			24.2	3	36.5	8		
	Red Rock							27.0	2	34.3	4		
	Nittany												
	Purkof	30.7	2	32.6	3	30.2	3	31.6	5	35.1	3		
	Michikof	28.8	3			30.5	3	26.6	5				
Wooster Hybrid Selections	T. N. 1006			32.1	2	31.4	2	31.5	3	34.8	2	21.3	3
	T. N. 1016					34.8	2			36.9	2	21.8	2
	T. N. 1029			32.9	2	31.7	2	30.0	2	35.3	2	21.7	2
	T. N. 1033					32.6	2			34.1	2	21.4	2
	T. N. 1043	31.6	2	32.9	2	32.0	2			33.9	2	21.8	2
	T. N. 1047	30.7	2	32.5	2								
Columbus Hybrids & Selections	O. S. U. 101- 3	29.6	3	31.9	3			29.5	4	32.2	3	22.0	2
	O. S. U. 139- 7			31.4	3								
	O. S. U. 139-10											21.6	2
	O. S. U. 168-10												
	O. S. U. 15174	31.9	8	31.7	5			25.5	3				

TABLE 3.—Variety Wheat—Winter Wheat on Outlying Farms—Continued

Yield per acre corrected to average yield of Trumbull in all cases

	Variety	Trumbull		Mahoning		Belmont		Meigs-S. E. Exp.		Washington		Cuyahoga-N. E. Exp.		Hancock	
		Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested	Yield Bu.	Years tested
Wooster Selections and Parent Varieties	Trumbull	29.9	15	29.9	14	25.8	7	29.2	22	23.1	16	28.2	15	21.3	8
	Fultz	30.9	12	30.1	14			28.7	28	28.6	4	26.9	4	16.2	5
	Fulhio	29.5	14	30.9	14	28.3	7	31.2	8	26.1	8	27.6	7		
	Nigger	27.0	5	27.3	11	27.0	4	28.2	24	31.3	9	27.2	14	16.8	11
	Nabob	34.1	3	34.2	7			31.4	7	22.9	3	30.5	3		
	Gipsy			29.2	5			27.8	20			32.0	2	18.3	5
	Gladden	31.8	12	29.5	13	31.3	7	29.8	17	30.6	12	28.3	13	22.6	8
	Poole	28.9	13	28.2	12			28.8	27	22.9	4	24.7	7	17.5	5
	Portage	29.5	9	28.1	7			30.6	16						
	Ohio 9920	30.1	10	30.6	12	28.9	6	30.9	14	27.4	14	29.8	13	19.7	8
	Ohio 14085	30.3	4	34.2	5			32.1	4						
Standard Varieties	Dawson	30.0	11	28.7	10			20.3	5			20.5	3	19.6	12
	Fulcaster	33.9	2					21.8	4			23.9	2	18.1	13
	Mediterranean	28.9	7	28.2	9			27.9	21	26.6	11	26.8	15	19.0	9
	Valley	31.8	7	30.3	5			28.8	23			23.9	4		
	Goens	27.3	5	23.6	3			28.0	3						
	Velvet Chaff	26.7	9	25.5	7	28.1	6	26.6	21	25.6	9	23.5	12	15.4	13
	Rudy							27.1	19			17.3	3		
	Turkey Red							22.9	19			15.0	2	15.7	11
	Kharkov							30.0	7					20.4	3
	Kanred			30.9	3			26.2	2						
	Red Rock	30.0	3	29.4	4			31.4	4						
	Nittany	33.5	6	29.6	10			30.7	3	22.1	3				
	Purkof														
	Michikof														
Wooster Hybrid Selections	T. N. 1006	28.9	3	31.1	3			34.9	3	25.2	2	26.1	2		
	T. N. 1016							34.9	2	25.6	2				
	T. N. 1029							32.3	2	24.1	2	28.5	2		
	T. N. 1033											27.9	2		
	T. N. 1043							31.0	2			28.5	2		
	T. N. 1044	30.7	2					29.6	2						
Columbus Hybrids & Selections	O. S. U. 101- 3			27.8	2			33.1	2						
	O. S. U. 139- 7			31.5	2			27.7	3						
	O. S. U. 139-10	30.5	2					30.7	2						
	O. S. U. 168-10							35.9	2						
	O. S. U. 15174														

promising. Selections are being made with the object of combining greater winter hardiness with desirable field characteristics and milling quality. None have been sufficiently tested as yet, but indications are that the Experiment Station may be able to provide the Ohio farmer with still more satisfactory varieties—new lines which will be capable of returning still greater increases in production for the labor and fertilizer expended upon them.

RETURNS PER ACRE IN CATTLE FEEDING. IV

PAUL GERLAUGH AND H. W. ROGERS

During the past several years interest has been displayed in the comparative value of ground shock corn and silage as a feed for fattening yearling cattle. A test planned to contribute information on this point was conducted during the past season at the Madison County Experiment Farm, where H. W. Rogers is superintendent.

Alternate strips of 20 rows each were marked through the field. On September 7, Strips 1, 3, 5, and 7 were put into the silo. After putting Strip 1 into the silo, a few burlap sacks were split open and spread over the silage to preserve the identity of the area. This same practice was followed with each strip. There were 7.05 acres of corn in the four strips placed in the silo. About 3½ tons were placed above this measured area to take care of spoilage and to use for both lots until the test was started. One week after placing the corn in the silo, Strips 2, 4, 6, and 8 were cut and shocked.

Thirty-two head of yearling, white-faced steers were used in the test. Their weight was slightly under 700 pounds, their condition as feeders was medium, and their quality would doubtless have justified a grading of low choice. These steers were divided into two groups and fed silage and ground shock corn until the first measured strip was available in the silo. The test was then started—feeding silage from Strip 7 in the silo and ground shock corn from Strip 8.

A grinder of the hammer type, designed to handle roughage, was used. This mill carried as standard equipment several screens, the largest of which was of 1¼-inch size. This size was used.

Cottonseed meal was fed to both lots of steers at the rate of 2 pounds daily per steer, and clover hay was fed in such amounts as the steers wanted.

Silage and ground shock corn were full fed.

The performance of the two lots is shown in the accompanying table. A third lot is also shown in the table. This third lot, which was fed shelled corn and stover in a test conducted 3 years ago, is added to show the performance of steers slightly lighter than those used this year but of similar quality. In that test, returns per acre of corn, when fed as silage and as shelled corn and stover, were compared; the results are reported in Bimonthly Bulletin 139. The lot of steers on the silage ration in the 1928-1929 test made a similar gain in a test of similar duration. Market men who saw both lots stated that in their opinion the two groups of silage-fed cattle were sufficiently similar to justify the same appraisal. Three years ago, the silage-fed cattle were appraised at $14.00 per cwt. at the close of the test and the shelled-corn-fed steers at $14.75 per cwt. The silage-fed steers in this year's test were appraised at $6.25 per cwt. By ratio, the $6.58 figure was obtained as a market appraisal for use with Lot 3 shown in the table.

Strip 2, fed as ground shock corn, furnished 34 days' feed for Lot 2, while Strip 1, fed as silage, furnished 34¼ days' feed for Lot 1. A similar experience followed the feeding of Strips 4 and 3, showing a close relationship between the carrying capacity of a given area of corn when fed under conditions of the test. The amount of ground shock corn was increased at this stage. With the increase in the amount of ground shock corn fed, there was an increase in the amount of the coarser particles remaining in the troughs. The steers learned that, by manipulating the ground shock corn, the particles of grain would find their way to the bottom of the trough. The grain portion of the ration was consumed, but the coarser particles were left in the troughs during the latter part of the test. The 7.05 acres of shock corn were exhausted March 11, although similar corn was available for use until the silage supply was finished. The test was closed March 23, in order to have the figures available for a meeting of cattle feeders on March 25. About 6 days' supply of silage remained in the silo at the time the test closed.

Two pigs followed each lot of steers. Their gains were very similar.

The market appraisals were made by representatives of the Buffalo, Cincinnati, and Pittsburgh markets.

The value of the gains was arrived at by figuring the value of the steer at the feed lot weight shown in the table and the appraisal assigned. From this value was subtracted the cost of the steer at

the start of the test. The gain in value of the steer was divided by the gain in weight. The resulting figure was the value per cwt. of gain.

The gains per acre multiplied by the value of the gains gave the gross returns per acre of corn. The value of the cottonseed meal and of the hay eaten while the steers consumed an acre of corn needs to be taken from the gross returns to obtain the returns per acre of corn.

TABLE 1.—Madison County Experiment Farm
Summary cattle feeding test, 1931-1932

	Lot 1 Corn silage Clover hay Cottonseed meal	Lot 2 Ground shock corn Clover hay Cottonseed meal	Lot 3* Shelled corn Corn stover Clover hay Cottonseed meal
Number steers per lot	16	16	10
Cost of cattle at farm	$ 6.50	$ 6.50	$ 6.50
Average weight, Oct. 9, Lb.	693	685	607
Duration of test, Days	166	154	174
Average weight at close of test, Lb.	1027	963	998
Average daily gain, Lb.	2.03	1.81	2.24
Average daily ration, Lb.:			
Corn silage	48.2	...	...
Ground shock corn	...	24.8	...
Cottonseed meal	1.9	1.9	2.0
Clover hay	2.7	3.8	1.6
Shelled corn	...	...	16.3
Corn stover	...	...	9.5
Steer days fed per acre of corn	374	350	166
Cattle gains per acre of corn fed, Lb.	759	633	372
Hog gains per acre of corn fed, Lb.	17	17	67
Total pork and beef per acre of corn fed, Lb.	776	650	439
Market appraisal of cattle	$ 6.25	$ 6.00	$ 6.58
Value per cwt. of gain	$ 5.73	$ 4.77	$ 6.70
Gross returns from feed per acre	$44.25	$30.95	$27.93
Value of cottonseed meal and hay per acre of corn fed.	$13.06	$13.65	$ 5.21
Cost of preparing one acre of corn for cattle feed	$ 9.24	$19.09	$ 9.45
Net returns per acre of corn fed to cattle	$21.95	—$ 1.79	$13.27
Labor required to prepare standing corn as feed for steers:			
Man	28.3	53.6	40.5
Horse	26.9	18.7	18.0
Tractor	2.1	9.3	...

Prices: Cottonseed meal, $25 per ton; hay, $8 per ton; hogs, $4.50 per cwt. Man labor, $.20 per hr.; horse hour, $.075; tractor, $.75 per hr. Corn yielded 53 bu. of corn and 10.05 tons of silage per acre.
*Lot 3 results taken from 1928-1929 test, when corn yielded 48 bushels per acre.

Records were kept of the amount of labor necessary to handle the corn from the standing corn in the field until it was in the form fed to the steers. These figures are shown, together with the rate charged for man, horse, and tractor hours. The cost of preparing the corn for the cattle, together with the value of the cottonseed meal and hay, taken from the gross returns of the corn shows the net returns per acre of corn.

Records show that during the period of the test there was an excess of 4.3 inches of rainfall when compared with an average of the previous 14 years. December and January contributed most of this excess.

FREE CHOICE OF WHOLE GRAIN AND MASH CONCENTRATE FOR LAYERS

D. C. KENNARD AND V. D. CHAMBERLIN

One method of feeding suggests another. Chickens are so tolerant of rations and methods of feeding that what would seem to be intolerable extremes can be successfully employed; for example, a ration may carry protein, fiber, or minerals and the like in amounts generally considered as the proper amounts to be used, but, in many instances, the amounts may be increased 50 to 100 per cent and yet yield practically the same results insofar as production and mortality are concerned. That is why it can be said that there is no one best ration. Nor is there any one best method of feeding for all, since, in the chicken, we find extreme tolerance toward various methods of feeding. We may successfully feed all whole grain and no mash with liquid milk to drink instead of water, whole grain and mash, all-mash, free choice of whole grains and all the mash ingredients, or free choice of whole grains and a mash concentrate.

Recent tests by the Ohio Experiment Station indicate that the latter method has interesting possibilities in connection with economy of production, which has become the keystone to success in poultry keeping since the advent of low market prices for poultry products. Because feed is one of the most important cost factors, farm poultry keepers are seeking to take full advantage of the low price of whole grains by using as large a proportion of whole grains as possible.

This may be accomplished either by free-choice feeding of whole corn, wheat, and oats (also barley, if available) and liquid skimmilk or buttermilk to drink instead of water or by the use of the whole grains and a mash concentrate. Inasmuch as the large majority of farm poultry keepers do not have a dependable supply of liquid milk available, it is obvious that it would generally be more practicable if a mash concentrate could be effectively substituted

for milk. It was this fact and the promising possibilities of its accomplishment that suggested the new method of feeding—the free choice of whole grains and a mash concentrate. Consequently, in the fall of 1931 the Station began testing this method of feeding with 400 layers. The results are given in Table 1.

TABLE 1.—Egg Production, Body Weight, and Feed Consumption
November 11 to May 11—6 months

Ration	No. and kind of birds	Eggs per bird	Body wt.§	Feed consumption: Total av. per bird	Feed consumption: Whole corn	Feed consumption: Whole wheat‖	Feed consumption: Whole oats**	Feed consumption: Mash concentrate
			Lb.	*Lb.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All-mash	50 pullets*	80	3.42	37.24	35***	20***	20***	26.5
Grains / Mash concentrate	50 pullets*	67	3.58	34.77	31.62	50.27	6.68	11.35
All-mash	50 hens*	61	3.49	35.97	35***	20***	20***	26.5
Grains / Mash concentrate	50 hens*	63	3.49	37.19	33.42	39.95	9.07	17.56
Grains / Mash concentrate	40 pullets*	80	3.85	45.45	44.32	32.96	8.33	14.38
Grains / Mash concentrate	40 pullets*	84	3.77	37.92	31.08	40.59	8.75	19.57
Grains / Mash concentrate	40 pullets*	97	3.69	38.16	23.96	44.35	11.29	20.39
Grains / Mash concentrate	40 X pullets†	104	4.93	37.59	20.05	47.11	16.65	16.19
Grains / Mash concentrate	40 X pullets‡	105	4.56	39.87	18.65	45.93	15.77	19.65
Average					29	43	11	17

*Leghorns.
†White Rock male x Leghorn female.
‡Leghorn male x White Rock female.
§Monthly average.
‖Winter wheat.
**About 32 lb. per bushel.
***Ground.

RATIONS[1]

The mash concentrate was derived from an all-mash formula which has been used extensively with satisfactory results. After removal of the grains, the balance of the formula, composed of the protein, mineral, and vitamin concentrates, became the mash concentrate as follows:

[1]These are experimental rations. Formulas better adapted for practical purposes will be furnished upon request.

	All-mash ration	Free-choice ration		
Coarsely ground yellow corn	35	Whole grains Corn		
Coarsely ground wheat	20	Wheat		
Finely ground oats	20	Oats		
		Mash concentrate composed of:		
Wheat bran	5	5	x 3.73=	19
Meat scraps 50-55% protein	8	8		30
Dried skimmilk	5	5		19
Alfalfa leaf meal	5	5		19
Oyster shells, chick size	2	2		7.5
Salt	0.5	0.5		1.8
Cod-liver oil	1	1		3.7
	100.0	26.5		100.0

This rather crude mechanical method of formulating the mash concentrate was used because there were no precedents for guidance. This formula of mash concentrate was used in connection with the results reported herein, but it is not recommended for general use. However, with certain modifications it may serve as a suggestion until more suitable formulas are developed. In fact, it would seem that the protein supplements being marketed by a number of feed manufacturers should serve effectively as mash concentrates for the free-choice grain and mash concentrate method of feeding when it is preferable to secure the mash concentrate ready prepared. The only departure from the customary use of such feeds would be the free-choice feeding of the grains and the mash concentrate instead of mixing them.

The egg production was according to expectations for the age, breeding, and quality of the birds used. The first two groups of pullets are comparable to each other as are the two groups of hens, but all of the other groups differ somewhat as to breeding. The pullets on all-mash laid more eggs than similar pullets on the free-choice ration. This may or may not be of significance, especially when the better maintenance of the body weight of the latter group is taken into consideration. Of greater significance is the feed consumption and the variation in the amount of grains and mash concentrate consumed by the different groups. The all-mash ration required that 3.73 times as much grain as mash concentrate be consumed; whereas by free-choice the flock average was 5.9 times as much grain as mash concentrate. This appears to be quite a departure from the all-mash formula. However, a distinction should be made between the flock average and the individual feed consumption, which may be quite a different matter. A bird out of production or a poor layer would be expected to consume but

a small proportion of the mash concentrate; whereas a heavy layer is at liberty to consume even more of the mash concentrates than is included in the all-mash formula. Permitting the layer to eat according to her needs operates for economy. The less expensive grain part of the ration will largely serve the birds out of production; whereas those in production will instinctively crave and eat more of the mash concentrate required for producing eggs. If layers are denied shells or limestone grit for a few days, they will pile over each other as greedily to get their share when a fresh supply becomes available as if they were given fresh meat or liver. Why? Not necessarily because they like to eat shells or limestone grit but because of needing the lime to make egg shells, they instinctively crave and eat the lime material ravenously. It seems that the same principle applies to the mash concentrate and that the birds can be trusted to eat the mash or grains in proportion to their individual requirements. We are unable to account for the heavy corn and total feed consumption of the fifth group of pullets, except that they were a different and slightly larger strain of birds.

Notwithstanding the fact that the layers did not balance their ration as we would have done, we need not feel obliged to follow their dictates closely as signified by free-choice feeding; for example, the free-choice birds consumed only 11 per cent of oats and yet one of the best single feed mixtures we have tested contains 40 per cent oats—half ground and half whole.

FEEDERS AND FEEDING SPACE

Each 100 layers should have two feeders 8 feet long. These feeders, as described in Station Bulletin 476, "All-night Light for Layers", are 4 inches deep and 8 inches wide inside, with plaster lath nailed on the top edges of the sides and extending inside 3/4 inch to prevent wastage. A revolving pole 1½ inches square keeps the birds out of the feeder. The feeders are partitioned into separate compartments for the whole or cracked corn, whole wheat, whole oats, (whole barley, if available), mash concentrate, and oyster shells or limestone grit or both. The partitions should extend about 2 inches above the sides of the feeder or nearly to the bottom of the revolving pole to prevent the different feed materials in the separate compartments from becoming mixed. A 5-inch compartment on each end is desirable for shells and grit. The balance of the feeder may be partitioned into four compartments—the three for corn, wheat, and mash concentrate may be about 24

inches long and the one for oats about 12 inches. If a fifth compartment for barley is included, it may be made 10 to 12 inches long at the expense of the corn and wheat compartments.

When it is desired to include cod-liver oil in the ration, 2 to 3 per cent of the oil may be mixed in with the mash concentrate or some may prefer to mix ½ to 1 per cent of the oil with all the grains and the mash concentrate.

The free-choice feeding of grains and mash concentrate is suggested primarily for farm poultry keepers who produce their grains and who desire to involve a minimum of additional expense in balancing their poultry rations. Furthermore, this method involves the least amount of time and labor for feeding when other farm activities are pressing.

While this method of feeding appears to be well adapted for farm poultry keepers, it is not the present purpose to suggest it for commercial poultry keepers and others who figure that by pampering their layers in various ways they can secure sufficiently better results to justify the extra time and expense involved. As further information and experience are accumulated, this may become a needless qualification. Whether free-choice feeding of whole grain and mash concentrate will prove satisfactory for heavy breeds remains to be determined.

Finally, it should be emphasized that those who may desire to change to this method of feeding will need to exercise careful judgment and precaution in doing so. This, like any other radical change of ration or method of feeding, will require 4 to 6 weeks for the birds to become fully accustomed to the change. The opportune time for making such a change is before the pullets start to lay or when layers are off production because of molting or for other reasons. It should be expected that when a flock is in good production such a change would be followed by loss of production and possibly other complications.

FREIGHT RATES AND THE PRICE OF OHIO FARM PRODUCTS

J. I. FALCONER

Assuming that freight rates remain the same, high prices for farm products are to the relative advantage of states distant from market. On the other hand, with low prices for farm products the states distant from market suffer the greater loss. Potato prices will serve to illustrate this. During the past 10 years, nearly all Ohio potatoes have reached the market by means of the motor truck. Michigan, Minnesota, and Maine, on the other hand, are all surplus-potato-producing states where a large percentage of the crop is shipped by freight. During the 5 years of the period when the Ohio farm price of potatoes on January 15 was over $1.00 per bushel, the Ohio farm price averaged only 37 per cent above the price in the other three states. During the 5 years, however, when the January 15 Ohio farm price was below $1.00 per bushel, the Ohio price was 97 per cent above that of the average of the other three states.

The foregoing would seem to indicate that, while present prices are hard on all producers, the situation does at least give a greater relative price advantage to the near-by producer as compared to the producer in states more distant from the market.

TABLE 1.—Farm Price of Potatoes on January 15

Year	Cents per bushel				Per cent Ohio price was of other three	
	Ohio	Michigan	Minnesota	Maine		
1926	234	213	196	230	110	
1927	165	115	114	122	141	
1930	155	135	110	130	124	137
1928	125	80	60	90	163	
1931	110	85	65	75	145	
1924	95	51	50	85	153	
1925	92	42	37	41	230	
1923	88	39	39	52	205	196
1929	75	35	35	45	197	
1932	55	28	31	25	197	

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Price declines continued from January to May. In the latter month the wholesale price level was 39 per cent below that of May 1920, while the price level of Ohio farm products was 27 per cent below that of May 1920. Although the general price level has continued to decline since January, that of Ohio farm products has remained relatively stable since February. The greatest decline in Ohio farm products prices since January has taken place in wool. Industrial payroll totals are about 50 per cent of the 1926 level.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913	102	...	100	100	104	100	105	100
1914	99	100	101	102	102	102	105	107
1915	102	101	106	100	103	107	106	110
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	141	232	156	139	169	96	154	147
1929	139	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	128	130
1931	107	...	129	80	120	82	89	93
1931								
January	114	212	137	94	133	...	104	115
February	112	215	136	90	...	...	96	85
March	111	219	134	91	...	82	98	104
April	109	215	133	91	119	...	102	97
May	107	211	130	86	...	...	96	90
June	105	207	129	80	...	...	92	93
July	105	207	128	79	115	...	84	86
August	105	207	127	75	...	...	86	90
September	104	205	124	72	...	...	82	87
October	103	199	122	68	116	...	77	86
November	102	196	120	71	...	...	79	93
December	100	194	119	66	...	...	72	88
1932								
January	98	191	118	63	100	...	69	81
February	97	189	116	60	...	...	64	68
March	96	189	115	61	...	70	64	68
April	95	...	114	59	...	...	64	67

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

Army plane carries first aerial shipment of forest trees made in Ohio

QUALITY WHEAT FOR OHIO

E. G. BAYFIELD

The combination of soils and climate which Ohio possesses permits the wheat growers of the State to grow a premium price wheat. At the present time, Ohio wheat enjoys an enviable position in the eyes of the milling trade which buys the crop, due to the fact that a relatively small amount of wheat unsuited for Ohio conditions is being grown. The milling industry wants the soft winter wheats produced in Ohio, as these wheats possess certain peculiar characteristics which make them suitable for special market purposes. Hard winter wheat varieties, when grown under Ohio conditions, do not possess the same quality characteristics as do the soft winter varieties. The growing of hard winter wheat types would reduce the average quality of Ohio wheat and destroy the present market values. The highest possible price is desired by all growers, and this can only be obtained by producing a quality product.

Ohio wheat is used principally for the manufacture of flour to be used in making soda crackers, cakes, cookies, pastry, and breakfast foods. Little of Ohio wheat is used for bread-making, as is the case with wheat grown in the Great Plains Region farther west. Quality in Ohio wheat, therefore, means something quite different from quality in Kansas or Minnesota wheat. Quality in Minnesota wheat, for example, is shown by a high test weight per bushel, by a high crude protein content (12 to 18 per cent), by a low moisture content, and by a hard vitreous or flinty appearance. Quality in Ohio wheat, on the other hand, demands a high test weight, a medium moisture content, a crude protein content of about 9.5 to 10.5 per cent, a softer texture, and an opaque appearing grain.

If a representative sample of Minnesota wheat is placed beside a sample of good Ohio wheat, there is no difficulty in distinguishing between them. The Ohio sample would not have the glassy or vitreous appearance, although both would be plump and have the characteristic bloom common to all sound wheats. The vitreous appearance of the Minnesota sample would be largely due to its high-protein content, and this high-protein content makes this class of wheat unsuitable for many of the purposes for which Ohio wheat is especially useful. Everyone has chewed a sample of wheat and obtained the familiar gummy-like material, which is obtained as a result of removing the starch from the wheat, leaving a mixture of

branny material mixed with the gluten of the wheat. This gluten is the principal part of the nitrogenous material determined by means of the crude protein chemical determination. Protein in wheat is the most important single ingredient, and, when it is removed, very little besides starch is left. Without the protein bread could not be made from flour, and flour would be somewhat similar to corn or potato starch.

All wheat protein does not possess the same quality, but the Ohio farmer is fortunate in having available a number of recommended varieties of wheat (Trumbull, Fulhio, Nabob, and Gladden) which possess a good quality of protein. Varieties such as Michikof have not been approved because its gluten is of inferior quality. Furthermore, a great many other new varieties have never been distributed for the same reason. It has been realized that unless Ohio continued to produce its superior type of soft red winter wheat the special market demanding this wheat would be lost and lower prices would prevail. Hard winter wheat varieties, such as Kharkov, Turkey Red, Kanred, and Purkof, should not be grown as they do not possess the characteristics found in varieties such as Trumbull or our other typical soft red winter varieties.

A number of factors regulate the amount of protein in wheat. Some of these factors may be influenced by the grower; whereas others, such as rainfall or temperature, have to be accepted as received. Climate has the largest influence of all factors, but the soil and treatment of the soil produce almost as much variation in the amount of protein as does climate under Ohio conditions. Generally speaking, any soil which possesses a plentiful supply of available nitrates during the filling and ripening period will produce the most protein in the wheat. Plentiful supplies of soil nitrates in the spring are normally used in increasing the yield per acre by increasing the number and size of tillers and wheat heads. With this increase in vegetative growth there may actually be a shortage in available nitrates later in the season, and, provided a cool moist ripening period occurs, a low protein crop results. Should, however, the ripening period be hot, dry, and of short duration, then wheat will be of higher protein content with a low test weight per bushel. This low test weight reduces the value of the crop because low test weight wheat will not produce as much flour per bushel as normal weight wheat. However, usually under Ohio conditions there is plenty of moisture available, ripening occurs in a normal manner, and the supply of available soil nitrates regulates the protein content in the ensuing crop.

The average results obtained with 10 different varieties grown at various locations in 1931 will serve to illustrate the effect of soil type and climate upon the quality of Ohio wheat. These results are given in Table 1.

TABLE 1.—Average Results from 10 Varieties Grown in 1931

County	Yield per acre	Test weight	Crude protein	Soil type
	Bu.	*Lb.*	*Per cent*	
Fulton	13.4	58.9	8.82	Plainfield fine soil
Fulton	22.9	59.4	9.10	Wauseon loamy fine sand
Fulton	Missing	59.4	9.09	Napanee clay loam
Fulton	40.7	59.7	10.10	Brookston clay
Fulton	40.2	59.1	9.97	Brookston clay loam
Mahoning	36.0	60.1	9.95	Canfield-Volusia silt loam
Wayne	45.3	57.0	9.86	Wooster silt loam
Knox	32.4	58.1	9.74	Wooster silt loam
Franklin	37.5	55.8	10.71	Miami silt loam
Miami	30.2	54.5	11.16	Miami silt loam
Hamilton	Missing	52.5	12.74	Russell silt loam

The Fulton County samples were grown under conditions where the effect of climate was eliminated. Fertilizer treatments were the same. From this table we see that those soils naturally less fertile (i. e., light colored soils, such as the Plainfield and Napanee) produce less protein, as well as fewer bushels per acre, when compared with the darker colored and more fertile soils (Brookston and Wauseon). The sand soils as a class, due to their poorer water-holding capacity and general fertility, also produce less protein than the heavier textured soils. The lower half of Table 1 illustrates how climate affects the same varieties when grown at various separated locations running across the climatic zones of the State. These 1931 results show the same general trends as were found in samples grown at the same locations in 1930. There is a general rise in protein content as one goes from Northeastern to Southwestern Ohio. The very high protein from Hamilton County was partly due to excessive lodging, which prevented the obtaining of reliable yield data.

Fertilizer treatments affect the protein content, due to the elements provided as plant food. Phosphatic fertilizers tend to reduce the protein content. Thus, at Wooster in 1931, wheat grown in the 5-year rotation produced wide variations in protein. The application of 160 pounds of 16% superphosphate reduced the protein content 4.1 per cent (Plot 4, no treatment—14.3 per cent; Plot 2, phosphated—10.2 per cent). The application of phosphatic fertilizers, therefore, provides a readily available means of reducing the protein content in areas producing excessive amounts of protein.

Potash fertilizers do not appear to have much influence upon the protein content although they are very essential for good growth in the plant as a whole. Lime tends to increase protein, this increase being due, to some extent, to the increased amount of legumes growing on limed soils. The increase in protein from liming is further demonstrated by the fact that, on the average, wheat grown on soils derived from limestone in the western half of Ohio normally possesses more protein than wheat raised on soils derived from sandstone and shale in the eastern half of Ohio.

Nitrogenous fertilizers are the most expensive to purchase. There are several forms of nitrogenous fertilizers on the market, such as ammonium sulphate, sodium nitrate, urea, dried blood, and a number of others. Before these fertilizers are used by the plant, however, they are very largely converted into soluble nitrates. The plant has available, therefore, nitrates from commercial fertilizers, as well as nitrates from crop residues present in the soil which are being broken down by soil organisms.

The practice of topdressing wheat in the spring with nitrogenous fertilizers has been used to some extent recently. In order to determine whether this practice was detrimental to the quality of the Ohio crop, a number of samples was collected from cooperating farmers in different parts of the State. Data from the 1929 and 1930 indicate that ordinarily the practice does not increase the protein significantly. The protein results obtained on part of these samples are given in Table 2.

TABLE 2.—The Effect of Topdressing Wheat in the Spring, 1929

Variety	County source	Test weight		Protein		Fertilizer application
		Not topdressed	Topdressed	Not topdressed	Topdressed	
		Lb.	*Lb.*	*Pct.*	*Pct.*	*Lb.*
Trumbull	Pickaway	56.7	57.0	7.80	8.56	200 Calnitro
Trumbull	Marion	57.2	56.6	9.02	9.90	101 Calnitro
Trumbull	Marion	57.8	57.8	8.09	8.24	103 Calnitro
Trumbull	Wyandot	58.5	56.2	10.19	10.26	120 Calnitro
Trumbull	Seneca	56.1	57.4	8.22	9.44	120 Calnitro
Trumbull	Stark	58.2	57.6	10.28	9.96	Amount unknown
Fulhio	Licking	56.4	56.9	7.99	8.02	140 Calnitro
Fulhio	Wayne	57.4	56.8	8.18	8.36	150 Calnitro
Fulhio	Wayne	55.5	55.5	9.73	9.77	150 Sodium nitrate
Not named	Fairfield	57.6	57.6	8.00	7.91	156 Sodium nitrate
Average		57.1	56.9	8.75	9.04	

Data obtained from the 1930 crop samples are not presented here, due to lack of space. However, samples collected from 10 different locations produced an average protein content of 10.48 per

cent in the wheat not topdressed; whereas that topdressed produced only 10.53 per cent, an insignificant increase in protein content. The topdressed wheat weighed the most, averaging 61.5 pounds per bushel, while the untreated wheat weighed 61.2 pounds.

We may conclude from our topdressing studies and from other work which is in progress that the effects of nitrogenous fertilizers upon the quality of wheat are:

(1) Nitrogen fertilizers applied in the fall or early in the spring in moderate quantities do not materially increase the protein content, as the added nitrogen is used by the plant to produce larger yields per acre.

(2) Should there be more nitrogen added than the plant uses in the spring, the excess may be carried over until filling and ripening time and then stored in the wheat berry, producing an increase in protein content.

(3) In some cases, topdressing wheat in the spring actually produces a lower protein content in the harvested crop. This is the result of stimulating growth in the spring to such an extent that there is a deficiency in the supply of soil nitrates during filling and ripening. A low protein wheat crop then results.

Another factor which often causes large money losses to the wheat grower is that of diseases in wheat. Loose smut can very easily reduce the yield per acre by 5 or 10 per cent, although the quality of the harvested crop is not impaired for flour-making purposes. Stinking smut or bunt, on the other hand, if present to any great extent will cause a serious drop in the market value of the crop. This is due to the fact that it causes the miller considerable expense in removing the smut from the wheat before it can be milled. If left on the wheat, the smut darkens the color of the flour and imparts an undesirable odor to it. Scab is another disease which reduces the milling value of wheat. Rust, although not as important in Ohio, will reduce the acre yields and produce low test weight wheat.

Unfavorable harvesting or storage conditions also reduce the general quality and appearance of the crop. Sprouting of grain due to wet harvesting weather is known to everyone and this reduces the quality of the wheat for the miller and ultimate consumer. Storage of wheat when too moist produces mustiness which seriously affects the value of the crop. Weevils and other insects produce unsound grain and must be guarded against. Badly weevil-infested grain heats and develops a very bad off-flavor and, as such flavors are imparted to the flour, is discriminated against by the wheat

buyer. However, most of the troubles due to storage or harvesting are accidental and are difficult to avoid in actual practice. These losses can be and should be reduced to a minimum by seeing that the grain is dry when stored and weevil infestation kept down by fumigation.

It has been shown that the question of quality in Ohio wheat is different from areas where harder wheats are grown primarily for bread production. Ohio wheat should not be too high in protein content, and only soft winter wheat varieties should be grown. Having selected a good variety, such as Trumbull or Fulhio, the grower may then regulate the quality to some extent under favorable climatic conditions by selecting the right soils and using the correct fertilizer and soil treatments.

THE PRESENT HESSIAN FLY SITUATION

T. H. PARKS

Just previous to the 1932 wheat harvest, the entomologists of the Ohio Experiment Station, the Ohio State University, and the State Department of Agriculture conducted an annual wheat insect survey to determine the progress or decline of Hessian fly and other wheat insects. The main purpose of this annual survey is to determine the present Hessian fly population and its significance as compared with the population found present during the previous season. If Hessian fly is found to be on the increase, the survey points out in what parts of the State this has happened and in what counties control measures are most needed. The farmer is warned, through this survey, of the approach of Hessian fly outbreaks, even though he has not observed the increase in fly population.

The 1932 wheat insect survey reveals that the Hessian fly has made a very significant and unexpected increase in numbers during the last year. Twenty-four counties were visited by the entomologists in making this year's survey. It was found that 35.5 per cent of the wheat straws were infested with Hessian fly flaxseeds and most of these flaxseeds now remain in the stubble, where they will give rise to adult Hessian flies that infest early sowed and volunteer wheat. There are now over three times as many flaxseeds present as there were in 1931. The present infestation is surpassed only by that of 1920, which is well remembered by Ohio farmers as a year when heavy fly loss occurred to the wheat.

The following is the summer infestation by years, since the wheat insect survey was started in Ohio:

Year	Per Cent	Year	Per Cent
1918	1	1925	7
1919	14	1926	9
1920	44	1927	21
1921	17	1928	13
1922	11	1929	4
1923	5	1930	7
1924	12	1931	12
		1932	35

The recent increase in fly infestation is one of the surprises of the survey made this year. Another surprise was the absence of fallen straws, even though they were infested with fly, and the good yield and high quality of wheat secured in most fields, many of which had over 50 per cent of the straws bearing flaxseeds.

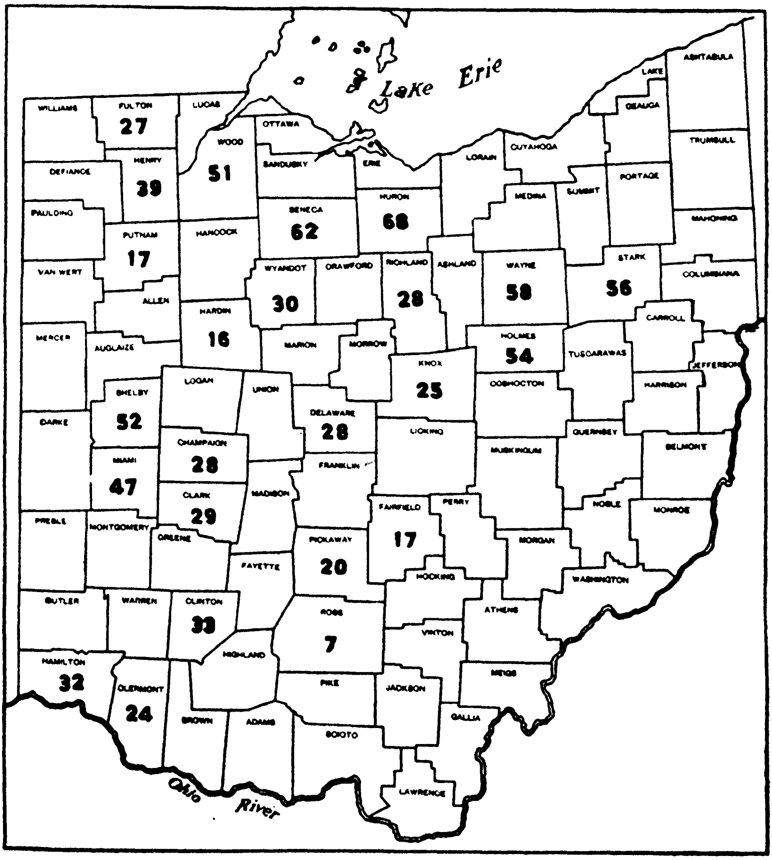

Fig. 1.—The figures indicate the percentage of wheat straws infested with Hessian fly in the counties visited in the 1932 survey

Infested straws usually remained standing this year and matured a fairly good head, for which we must give credit to the weather. The lack of fly damage in the July crop is leading many Ohio farmers to overlook the seriousness of the present Hessian fly situation.

The accompanying map, Figure 1, shows the percentage of straws found infested in each county visited by the entomologists. The fields inspected were chosen at random and without reference to date of sowing. In most cases, early sowed fields carried more Hessian fly than those sowed after the fly-free date, but many fields sowed after the proper dates were heavily infested. This was due to the spring brood of adult flies which emerged from early sowed fields and from volunteer wheat.

The relation between time of sowing and fall infestation of wheat is always clearly defined; to illustrate, the writer, during November 1931, visited the Madison County Experiment Farm and inspected wheat on that and other farms in the community. The following are the percentages of plant infestation found at that time:

Date sowed	Plant infestation in November
	Per cent
September 28	44
September 29	32
September 30	18
October 1	5
October 2	0

In northern Pickaway County, not only the fall infestation but also the summer infestation were determined for a series of sowing dates. These were as follows:

Date sowed	Plant infestation in November	Straw infestation in June
	Per cent	*Per cent*
September 25	52	30
September 29	48	53
October 3	9	32
October 5	0	5

Inspections made in November nearly always reveal the presence of some Hessian fly larvae in wheat sowed after the fly-free dates, but these larvae usually do not mature before the ground freezes and most of them are killed during the winter. The fly-free dates, as they have been worked out in Ohio and checked during the last 12 years, are thought to be sufficiently safe from fly infestation

to consider them permanent dates and are not subject to change unless the degree of fly infestation justifies it. In most parts of Ohio they are sufficiently early to enable the wheat to get a good start before winter arrives, providing the seedbed has been well prepared and fertilized. On poorly drained land and in some types of soil common to northeastern Ohio, sowing earlier than the fly-free date is at times justified. In other parts of Ohio there is little excuse for sowing wheat before the fly-free date, since the Ohio Experiment Station has shown that the maximum wheat yields are secured from wheat sown on or immediately after the dates safe for Hessian fly control. Rye can be sowed early, if desired, as it does not become heavily infested with fly.

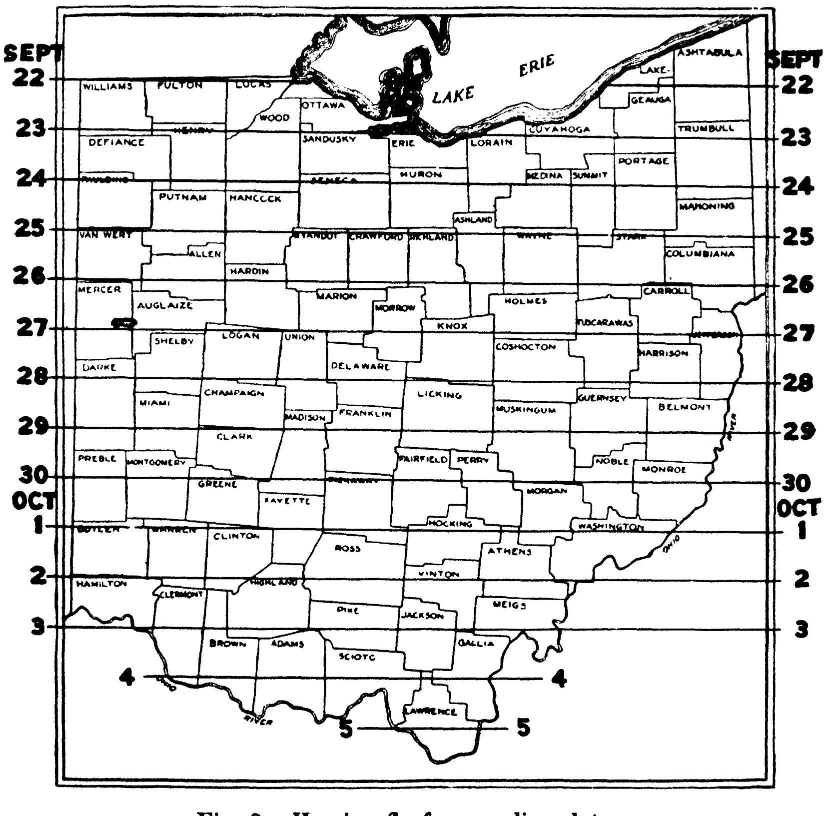

Fig. 2.—Hessian fly-free seeding dates

The 1932 wheat insect survey revealed a substantial increase in fly infestation in 21 of the 24 counties visited. The greatest increase was found where early sowed wheat prevailed. A large

percentage of flaxseeds has been killed during the summer by weather and parasites, and the Hessian fly situation must not be considered as alarming. However, wheat growers would do well to wait until the fly-free dates this year, if they wish to secure the maximum wheat yields in 1933. Seeding should proceed promptly after these dates and on a well prepared and fertilized seedbed.

THE POSSIBILITY OF A HOME-GROWN DAIRY RATION

C. F. MONROE AND C. C. HAYDEN

As a general rule, the feeds which a farmer raises are cheaper than those which he buys commercially. This price difference comes from the fact that there are no handling or profit charges on home-grown feeds. In fact, it often happens that the farmer finds it less expensive to use the grain from his own bins than to haul it to market and bring back a slightly cheaper grain. The main objection to using too large an amount of home-grown feed is that it does not make a suitable dairy ration, because of a lack of protein and phosphorus. The all too common farm-grown ration, composed of timothy hay and corn fodder with corn-and-oats chop, is not conducive to the best results.

The present economic condition has reduced the farmer's purchasing power; at the same time, there has been little demand for farm grains. Hence, dairymen are using larger quantities of their own grains. Fortunate indeed is that man who finds that he has the proper feeds in his barn for a good dairy ration.

In order to determine just how much could be expected from a home-grown ration and in order to determine the effect of feeding a large amount of wheat, an experimental home-grown ration containing 50 per cent wheat was fed to a group of cows. For comparison with this, the Station's regular herd ration, which contains wheat bran and linseed oilmeal as purchased feeds but no wheat, was fed as a check ration. These two rations were made up as shown in Table 1.

Twelve cows, ten Jerseys and two Holsteins, were fed these rations for two periods of 75 days each. The cows were divided into two groups of six each, the two groups being fed the two rations alternately. The results are based on the last 61 days, or 2 months, of each period.

TABLE 1.—Rations Used

	Home-grown	Check	Digestible crude protein
	Lb.	*Lb.*	*Per cent*
Corn	250	400	7.12
Wheat	500	....	8.37
Oats	250	300	11.90
Bran	....	100	12.62
Linseed oilmeal	....	100	32.04
Bonemeal	20	....	4.29
Salt	10	9	....
Digestible crude protein	8.76	11.97	....
Roughages:			
Alfalfa hay (2nd cutting)	....	....	11.23
Corn silage	....	....	1.38

Table 2 gives the results for these two periods.

TABLE 2.—Summary of Production and Liveweight Gains per Cow per Month with Average Daily Rations

Two periods of 75 days each, 12 cows

Ration	Milk	Test	Fat	F. C. M.*	Live-weight gains	Av. daily feed consumption		
						Grain	Hay	Silage
	Lb.	*Pct.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Check	787.8	4.91	38.65	894.9	22.0	11.59	12.72	22.64
Home-grown	773.0	4.95	38.24	882.8	18.0	11.42	12.78	22.93
Difference favors check	14.8	-0.04	0.41	12.1	4.0	0.17	—0.06	—0.29

*F. C. M. = Fat-corrected milk, or "4% milk", determined as follows: pounds milk x .4 plus pounds fat x 15.

One hundred pounds of 4% milk required:

	Grain	Hay	Silage
	Lb.	*Lb.*	*Lb.*
On home-grown ration	39.46	44.15	79.22
On check ration	39.51	43.35	77.15

At the end of the first two periods, three Jersey cows in each group were still milking well and were far enough away from their drying-up dates to warrant another feeding period of 75 days. The feeding history of these cows ran as follows:

	Oct. 16-Dec. 31, 1931	Jan. 1-Mar. 16, 1932	Mar. 17-May 31, 1932
Group I—3 Jerseys	Check ration	Home-grown ration	Check ration
Group II—3 Jerseys	Home-grown ration	Check ration	Home-grown ration

TABLE 3.—Summary of Production and Liveweight Gains per Cow per Month

Three periods, 75 days each, six cows

Ration	Milk	Test	Fat	F. C. M.	Liveweight gain
	Lb.	Per cent	Lb.	Lb.	Lb.
Group I					
Check (Av.)	797.0	5.10	40.61	927.9	14
Home-grown	783.4	5.40	42.34	948.5	16
Difference favors check	13.6	0.30	1.73	20.6	−2
Group II					
Check	761.2	5.32	40.47	911.5	15
Home-grown (Av.)	743.6	5.30	39.43	888.9	16
Difference favors check	17.6	0.02	1.04	22.6	−1
Both groups					
Check	779.1	5.20	40.54	919.7	14.5
Home-grown	763.5	5.36	40.89	918.7	16.0
Difference favors check	15.6	−0.16	−0.35	1.0	1.5

The results shown in Table 3 would indicate that the rations were approximately on a par. The small differences shown, which mostly favor the check ration, fall within the limit of experimental error and are not considered significant. The differences mostly fall between 1 and 2 per cent. A study of the production of the individual cows on the two rations fails to reveal any marked superiority for either ration. A Holstein cow (No. 352), a persistent and regular producer, gave the following yields of fat-corrected milk: first period, 2210.3 pounds; second period, 2209.9 pounds; third period, 2185.0 pounds. In the first and third periods, she received the check ration; whereas, in the second period she received the home-grown ration. A more even production could hardly have been expected if this cow had received the same ration for the 7 months represented in the above three periods. Although not all the cows produced this evenly, the advantage given either ration was about equally divided among the cows.

CONTINUOUS FEEDING OF HOME-GROWN RATION

A third group of cows was fed continuously on the home-grown ration, the duration of the feeding ranging from 5 to 7 months. Some of the cows were fed this ration during their dry period.

The purpose of this continuous feeding was to determine any abnormal developments that possibly would not be discovered in the ordinary feeding period of 75 days, as used in the reversal part of the work. The results of this continuous feeding are given in Table 4.

TABLE 4.—Cows Fed Continuously on Home-grown Ration. Average Monthly Production of Milk and Butterfat

Cow No.	Date fresh	Feeding	Days in milk on experiment	Average monthly production			
				Milk	Test	Fat	F. C. M.
				Lb.	Per cent	Lb.	Lb.
Holsteins							
351	Jan. 17, 1932	Nov. 10–May 21	105	1222.1	4.35	53.17	1286.4
356	Dec. 11, 1931	Nov. 10–May 21	136	1070.7	3.64	38.93	1012.2
378	Nov. 13, 1931	Dec. 16–May 21	167	1061.1	3.93	41.70	1050.0
Average				1118.0	3.90	43.60	1116.2
Jerseys							
283	Jan. 10, 1932	Oct. 16–May 29	137	514.4	6.22	32.02	672.7
365	Oct. 13, 1931	Oct. 16–May 21	197	711.1	5.78	41.08	924.6
385	Nov. 22, 1931	Dec. 16–May 21	167	690.6	5.85	40.42	882.6
Average				638.7	5.91	37.84	826.6

The cows in this group apparently maintained a normal state of health with a normal production. The three Holstein cows averaged 43.6 pounds of butterfat per month, and the three Jerseys, 37.8 pounds. The Holstein average was high due to the production of Cow 351, with an average of 53.1 pounds of fat per month. This is the highest production made in this experiment, regardless of ration.

In the home-grown ration there was approximately 50 per cent wheat. As this ration gave satisfactory results and compared very favorably with the check ration which contained no wheat, it may be concluded that this large amount of wheat had apparently no detrimental effect.

Butter manufactured from the cream produced by the cows on the home-grown ration was somewhat inferior to that from the cows on the check ration. This difference varied somewhat with the various lots of cream. Swiss cheese was also made from the milk produced on the two different rations. There was some rumor that Swiss cheese could not be made from the milk of cows fed wheat, but the Swiss cheese made from the milk of cows receiving a

home-grown ration containing 50 per cent wheat was of good quality. The accompanying photograph shows a cross-section of the cheeses. This manufacturing work was conducted at the Ohio State University, under the direction of R. B. Stoltz, of the Department of Dairy Technology.

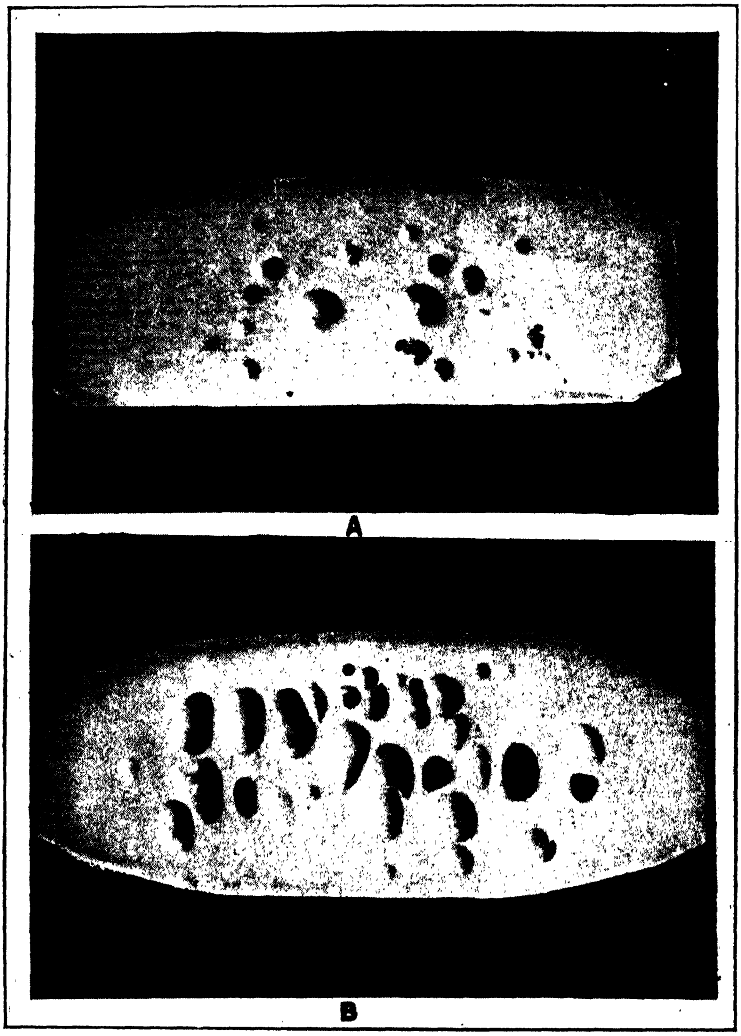

Fig. 1.—Swiss cheese made from milk produced on the two rations

A. From check ration containing no wheat.

B. From home-grown ration containing approximately 50 per cent wheat.

DISCUSSION

Dairying was formerly regarded as a side issue in Ohio. A few cows were kept to furnish a means for utilizing the rough feeds which were produced incidental to the general grain-farming scheme. With lower prices prevailing for grain and the increase in demand for milk, Ohio has rapidly become an important dairy state. On the individual farm, if dairying is to be followed, the farming operations should be planned accordingly. The first requirement of the dairy cow is for roughage. If the roughage raised on the farm is a good quality legume hay, the amount of protein concentrates required will be at a minimum or may even be omitted entirely in some cases, as was done in this experiment. Corn silage has a place in the dairy ration when not fed to excess. The combination of a legume hay and corn silage is ideal from a feeding standpoint and also from the standpoint of crop production. Although on many dairy farms it may not be possible to raise all the corn, wheat, or oats that is needed, these farm grains and others may be purchased locally at very reasonable prices.

In the experiment here described no new feeding "secrets" were developed. A good quality legume hay was fed liberally with a moderate amount of corn silage; the farm grains were fed liberally. The cows thus fed received adequate amounts of feed nutrients for the milk produced. Two per cent of steamed bonemeal was added to the grain mixture to overcome a possible phosphorus deficiency.

Heavy production has been emphasized very much in the last few years, but, in certain cases, a little lower production with cheaper feed costs may perhaps be justified. This is shown in the work described by A. E. Perkins of this department.[1] He found that, when milk was $2.10 a hundred, the cheaper of two rations, although yielding a little less milk, gave the same net return as did a higher-priced ration. When milk was below $2.10, the cheaper ration showed to even better advantage. The cheaper rations were obtained by using a smaller amount of purchased protein concentrates in the grain mixture and not by decreasing the amount of grain fed. This calls attention to the fact that feed prices sometimes get out of balance in respect to milk prices. When milk is low in price, it takes an extra amount to pay for some additional purchased feed. The heavier use of a cheaper ration may then become justifiable.

[1] Ohio Agricultural Experiment Station Bimonthly Bulletin, No. 147, November-December, 1930.

This experiment demonstrates the possibility of an entirely home-grown ration. Of course, circumstances may arise when this particular ration may not be as economical as other home-grown rations or other rations containing some purchased feeds. Wheat, the chief grain in this ration, can hardly continue to sell at the present low price. However, the chief reason for the good results from this ration was that a good quality legume hay was fed. It is this part of the ration which can be widely adapted. The high protein content of the hay used in this experiment made up for the low protein content of the grain mixture. If low-priced farm grains are to be utilized to the fullest extent in the dairy ration, they must be fed with a good quality legume hay, as the nutritional needs of the cow for milk production do not change with economic conditions.

COTTONSEED MEAL STUDIES

C. H. HUNT

A review of the literature relative to the feeding value of cottonseed meal reveals a considerable number of discrepancies as to its effect on livestock, other than hogs. For hogs, it is generally agreed that cottonseed meal, in an amount exceeding 10 per cent of the grain mixture, is poisonous. Cottonseed meal contains a poisonous principle called gossypol, and this is claimed by some to vary with the climate and soil upon which the cotton is grown. In the preparation of cottonseed meal, the seed is heated and then pressed to remove the larger part of the oil. In this process, a considerable part of the gossypol is destroyed or "bound" chemically, so that the meal is less toxic than the seed. It is this poisonous principle left in the meal that one has been taught to guard against when using cottonseed meal in livestock feeding.

The protein of the ration for livestock is the most expensive part of the ration, and it is also about the only part that the feeder is required to purchase. Cottonseed meal is rich in protein and is available in quantities at all times. It is also the cheapest protein supplement on the market at the present time. It was deemed important, therefore, to subject it to a biological analysis and to determine, if possible, just why it has a "bad reputation". From this, it was hoped that certain interpretations could be made that would be of value to livestock feeders.

The rat was used as the laboratory animal. Four rats, two males and two females, were placed on each diet, as shown in Table 1. In most cases each diet was again fed to four other rats.

TABLE 1.—Ingredients Used, Composition of Diets (Per Cent), and Average Weight of Rats (Grams)

Ingredients	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13	No. 14	No. 15
Regular cottonseed meal	98	82	94	84	88	84	84	84	84	......	84	74	......	74	......
Special cottonseed meal	......	......	......	......	......	......	......	......	......	84	......	......	74	......	84
Casein	......	16	......	10	......	......	8.0	8.0	10	10	10	......	......	......	......
Yeast	......	......	......	......	10	10	......	2.0	......	......	......	......	......	......	10
Autoclaved yeast	......	......	......	......	......	......	2.0	......	......	......	......	......	......	......	......
Corn	......	......	......	......	......	......	......	......	......	......	......	20	20	......	......
Alfalfa	......	......	......	......	......	......	......	......	......	......	......	......	......	20	......
Minerals {60% $CaCO_3$, 40% NaCl}	......	......	4.0	4.0	......	4.0	4.0	4.0	3.8	3.6	3.6	3.6	3.6	4.0	4.0
Iron oxide	......	......	......	......	......	......	......	......	0.2	0.4	0.4	0.4	0.4	......	......
Cod-liver oil	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Average weight, 12-week period	86	165	169	199	161	214	214	223	206	232	214	189	200	178	190

Generally, the rats were kept on the experiment longer than 12 weeks, in order to note the effect of the feeding on reproduction and nursing of the young.

The special cottonseed meal used was developed by the Proctor and Gamble Company, and it is supposed to have a lower gossypol content than regular cottonseed meal. Both the regular and the special cottonseed meals were made from seed from the same source.

The results of the experiment, except those of reproduction and nursing of the young, are shown in Table 1. The data show that cottonseed meal can be improved by supplementing it with a good protein and minerals. Cottonseed meal is thus shown to be similar to most plant proteins in that it is deficient in certain amino acids and minerals essential for the growth of the animal. In this experiment, the casein and yeast supply the missing amino acids; for practical feeding purposes, these probably can be supplied by tankage or meat scraps. In fact, Mr. Robison[1] of this Station, in his work with hogs, has proven that tankage can supply the deficient amino acids of cottonseed meal and thus largely vitiate the effect of the toxic principle, so that no deaths result. The data show that the deficiencies of cottonseed meal cannot entirely be overcome by corn or alfalfa or cod-liver oil. Iron oxide does not show any beneficial effect. It is interesting to note that cottonseed meal supplies sufficient of the vitamin-B complex for good growth when fed in the amounts indicated in Table 1. Yeast protein is as good a source of the deficient amino acids in cottonseed meal as that of the protein of casein. Examination of the data in Table 1 reveals that 84 per cent is about the maximum amount of cottonseed meal that can be fed to a rat and at the same time include the proper supplement which is necessary to make a complete diet. Mr. Robison, in his feeding work with hogs, found that 20 per cent is the maximum that can be fed to hogs. This shows that the hog is about four times as susceptible to the injurious principle in cottonseed meal as the rat. The special cottonseed meal gave slightly better growth than the regular meal. Reproduction and nursing of the young were very irregular and abnormal on all meals tried.

EFFECTS OF RAW COTTONSEED

In order to find out the relative destruction of gossypol in preparing the meals from the raw seed and at the same time to study the effect of supplementary feeding in overcoming the effect of the

[1]Ohio Experiment Station Special Circular 39.

deficiencies and the poisonous principle, an experiment was started with the raw, crushed seeds. Table 2 shows that about 20 per cent is the maximum amount of the raw, crushed seed, when properly supplemented, that can be fed and still obtain good growth. When the diet contained 30 per cent of raw, crushed seeds there were some deaths soon after the 12th week; with 40 per cent in the diet, nearly all were dead a short time after the 12th week. With the raw, crushed seed (40 per cent in the diet) there is no supplementary effect from casein, minerals, or iron oxide, showing that the toxicity of the seed is so great that it may be impossible to neutralize the effect of the poisonous principle by supplementary feeding. In some experiments with hogs, Mr. Robison has also shown that 5 per cent is about the maximum of raw, crushed seed that can be fed and not cause deaths. This again shows that the hog is about four times as susceptible to the deficiencies and toxicity of cottonseed meal as the rat.

TABLE 2.—Ingredients Used, Composition of Diets (Per Cent), and Average Weight of Rats (Grams)

Ingredients	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
Raw, crushed cottonseed	20	20	20	30	40	40	40	40
Corn	71	71	61	61	51	51	41	41
Alfalfa	5	5	5	5	5	5	5	5
Casein	....	....	10	....	....	....	10	10
Minerals*	4.0	3.8	3.8	4.0	4.0	3.8	4.0	3.8
Iron oxide	....	0.2	0.2	....	....	0.2	....	0.2
Average weight, 12-week period	140	138	190	88	100 3 dead	85 1 dead	97 3 dead	88 1 dead

*Same composition as that in Table 1.

A comparison of the toxicity of raw cottonseed and regular cottonseed meal shows that 20 per cent of the former is the maximum quantity that can be fed to the rat and still obtain growth and well being; whereas, 84 per cent of the latter can be fed without ill effects on growth, thus showing that about 75 per cent of the gossypol is destroyed in preparing the regular meal. The study also reveals a relative basis for comparing or interpreting the data with the rat in terms of those of the hog.

CONCLUSIONS

As a result of this study, it is concluded that cottonseed meal is deficient in certain amino acids, which go to make up the protein, and in minerals. When properly supplemented it is a good source of protein. The meal still retains some of its toxic principle, as evi-

denced by an abnormal reproduction in the rat, but this can be partially overcome by proper supplementary feeding. In the amounts fed, it is a good source of the vitamin-B complex. Iron oxide does not appear to be of any benefit in overcoming the harmful effects of its toxicity.

The study reveals the interesting fact that the rat is only about one-fourth as susceptible to cottonseed meal toxicity as the hog.

RELATIVE EFFICIENCY AND PROFITABLENESS OF THREE GRADES OF FEEDER STEERS. II

PAUL GERLAUGH AND C. W. GAY

This test is a continuation of the test conducted a year ago and reported in Bimonthly Bulletin 152 of the Ohio Agricultural Experiment Station.

The cattle used in the test were fed on the premises of the Ohio State University, under the direction of Dr. C. W. Gay, chairman of the Animal Husbandry Department of the University and a member of the Department of Animal Industry, Ohio Agricultural Experiment Station.

Three grades of steers—choice, medium, and common—were purchased on the St. Paul market on October 21, 1931. The choice steers cost $6.00 per cwt., the medium ones $4.50 per cwt., and the common ones $3.00 per cwt., on the market. An additional charge of $0.75 per cwt. was added to the market cost to cover buying charges, freight, and shrinkage en route.

Twelve steers were used per lot.

The choice steers were grade Aberdeen-Angus; the medium steers were grade Shorthorns. Most of the steers in the second lot carried horns. The common lot was composed of good representatives of the dairy breeds; nine of this last group showed characteristics of the Holstein breed; one was a Brown Swiss, one a Guernsey, and one a grade Jersey.

It should be remembered that the common grade of feeder steers at the stock yards includes the steers of the dairy breeds and the less desirable individuals which show color characteristics of the beef breeds.

Stockers and feeders were quoted in the October 21st issue of the *Chicago Daily Drovers Journal* as follows:

Inferior stockers	$2.50	–	$4.00
Stockers, common to fair	4.00	–	4.50
Stockers, fair to good	4.50	–	5.75
Stockers, good to choice	5.75	–	6.50
Fancy yearling stockers	6.25	–	7.00
Feeders, common to fair	3.75	–	4.50
Feeders, fair to good	4.50	–	6.00
Feeders, good to choice	6.00	–	6.75
Fancy yearling feeders	6.75		7.00

It is usually considered that the St. Paul market is about $0.50 per cwt. under similar grades at Chicago. This difference is due chiefly to the geographic location of the two markets with respect to the Corn Belt feeding territory.

After arrival at the feed lot, the cattle were rested about 2 weeks before they were started on test.

All lots were fed similarly. Ten pounds of silage, 3 pounds of mixed clover and timothy hay, and 1½ pounds of protein supplement were fed daily per steer, and corn-and-cob meal was fed in such amounts as the lot would consume. The protein supplement was made up of equal parts of linseed meal, cottonseed meal, and whole soybeans.

Ten pigs were given the run of the three lots, and their gains credited to the three lots of steers according to the amount of corn fed to the steers. Extra feed given the pigs was charged to the pigs at cost.

On March 25 a meeting was held at the feed lot. Representatives from several of the markets were present, as well as local buyers. Their appraisals are given, although no attempt is made to give the relative profitableness of the three grades at the end of 5 months in the feed lot, because of the difficulty involved in arriving at an average appraisal for Lots 1 and 2. The necessary selling price at this time is shown so that the reader may make his own comparison.

Lot 3, the common steers, was sold the Monday following the close of their 20 weeks on test, at an average of $5.35, through the Columbus auction. The selling expense was $0.25 per cwt., using feed-lot weight.

Lot 2 was fed for 24 weeks on test. It was planned to sell these cattle the week following, but, due to the condition of the fat cattle market, buyers could not be interested in them. Therefore, they were held on feed for an additional 2 weeks and sold for $5.65, with a selling expense of $0.27 per cwt.

Lot 1 was fed for 28 weeks and then shipped to Buffalo, where they sold on May 30 for $7.00 per cwt. on a dull market. It cost $0.90 per cwt. to cover shrinkage, freight, and selling expense. No

Market quotations*	1931 Oct. 21	1932 April 4	1932 May 16	1932 May 31
Low-grade steers	$4.75	$4.75	$4.85	$4.50
Common to fair yearlings	8.00	5.50	5.65	5.75
Fair to good yearlings	9.75	6.75	6.50	6.25
Good to choice yearlings	10.00	7.75	7.25	7.25
Choice to prime yearlings	10.65	8.25	7.75	7.75
Common to fair steers	6.25	5.50	5.65	5.65
Fair to good steers	9.00	7.00	6.50	6.25
Good to choice corn fed	10.50	8.00	7.25	7.25
Choice to prime corn fed	11.00	8.50	7.75	7.85

*The higher price quotation is used in this table, the average spread below these figures being approximately $1.00.

TABLE 1.—Relative Efficiency and Profitableness of Different Grades of Feeder Steers—II

The Ohio State University—1931-1932

	Lot 1		Lot 2		Lot 3
	Nov. 10 to Mar. 29	Nov. 10 to May 24	Nov. 10 to Mar. 29	Nov. 10 to Apr. 26	Nov. 10 to Mar. 29
Number of steers in lot	12	12	12	12	12
Number of days on test	140	196	140	168	140
Average weight at start, lb.	591	591	599	599	530
Cost per cwt. at start*	$ 6.75	$ 6.75	$ 5.25	$ 5.25	$ 3.75
Average weight at close, lb.	917	1031	940	997	852
Average daily gain, lb.	2.35	2.24	2.43	2.37	2.30
Average daily ration, lb.:					
Corn-and-cob meal	14.0	14.0	14.0	14.0	13.7
Protein supplement†	1.5	1.5	1.5	1.5	1.5
Corn silage	10.0	10.0	10.0	10.0	10.0
Mixed hay	3.0	3.0	3.0	3.0	3.0
Feed per cwt. gain, lb.:					
Corn-and-cob meal	596.0	628.0	581.0	595.0	597.0
Protein supplement	64.0	67.0	62.0	63.0	65.0
Corn silage	425.0	445.0	410.0	421.0	434.0
Mixed hay	125.0	131.0	123.0	126.0	129.0
Feed cost per cwt. gain	$ 5.35	$ 5.62	$ 5.20	$ 5.33	$ 5.40
Necessary selling price, March 29 (feed-lot weights)	$ 6.25	....	$ 5.32	....	$ 4.37
Market appraisal, March 25:					
Buffalo	$ 8.25	....	$ 6.50	....	$ 5.25
Cincinnati	$ 6.75	....	$ 5.50	....	$ 5.00
Columbus (stock yards)	$ 6.50	....	$ 5.65	....	$ 5.00
Columbus (David Davies)	$ 6.00	....	$ 5.25	....	$ 4.75
Marysville	$ 6.00	....	$ 5.25	....	$ 4.75
Pittsburgh	$ 7.00	....	$ 5.75	....	$ 4.75
Net returns when sold (per lot)	....	$753.34	....	$662.17	$527.37
Cost as feeders plus feed cost (per lot until sold)	....	$779.96	....	$662.36	$456.33
Profit or loss	....	—$ 26.62	....	—$ 0.19	$ 71.04
Pork credit per lot	....	$ 15.45	....	$ 14.61	$ 11.07
Profit or loss, pork included	....	—$ 11.17	....	$ 14.42	$ 82.11
Returns per bushel of corn (with pork credited)	....	$ 0.376	....	$ 0.431	$ 0.637

*75¢ per cwt. added to market price for delivery charge.
†Protein supplement: equal parts linseed meal, cottonseed meal, and soybeans.
Feed prices: corn-and-cob meal 40¢ per bu.; silage $3.50, linseed meal $30.00, cottonseed meal $25.00, soybeans $10.00, hay $8.00 per ton.

other steers sold on that Monday at Buffalo above $6.65 per cwt., showing that this group was quite desirable. During the 6 weeks following the date of their sale, the market advanced $2.00 per cwt.

Quotations of fat cattle from the *Chicago Daily Drovers Journal* are given for the period when the three lots were purchased and were marketed.

CONCLUSIONS

1. There was little to choose between the three grades in their ability to make efficient gains. It should be remembered that the common steers were good dairy-bred steers rather than poor individuals of the beef breeds. This point is of importance because, surely, many of the common feeder steers seen in the stock yard alleys would not gain as well as those of this group.
2. The spread in price between plain and choice fat cattle is narrow during the spring months.
3. The common grade of steers received the "breaks" in this test.
4. The local killers and the small markets appraised the various grades quite differently from the terminal markets.
5. The season of year when fat cattle are to be marketed and the place of marketing are important factors in determining the preferable grade of cattle to feed.

THE RELATION OF PRICE TO THE PHYSICAL CHARACTERISTICS OF SOME WHITE COTTON FABRICS

MARION GRIFFITH AND HELEN STROW

In this study, a few of the many white cotton fabrics used in the household and for wearing apparel have been considered.

Quality may be defined as the ability of a fabric to wear a long time without breaking through. In addition to quality, other factors enter into the suitability of the fabric for a particular use. The price of a fabric is seldom an indication of quality, but price certainly must be considered in the final choice. In the case of cotton fabrics, shrinkage must also be taken into account, as shrinkage is a factor worthy of consideration in the construction of garments. Thickness, construction, thread count, weight, yarn count, and yarn diameter are other factors which influence the quality and adaptability of a fabric.

The final test of the strength of a piece of cloth is the determination of the wet and dry breaking and bursting strengths and the determination of the strength-weight factor.

TABLE 1.—Physical Analysis of Fabrics

Fabric	Cost per square yard	Construction	Thickness in inches	Weight in ounces per square yard	Percentage shrinkage		Yarn count in yards per lb.		Diam. of yarn in inches	
					Warp	Filling	Warp	Filling	Warp	Filling
	Dol.									
Broadcloth A	1.36	Cord weave	0.0060	2.81	2.10	0	88	82	0.0042	0.0047
Broadcloth B	1.01	Cord weave	0.0050	2.72	0.84	0	76	70	0.0046	0.0047
Broadcloth C	0.80	Cord weave	0.0070	2.95	0.52	0	77	75	0.0048	0.0047
Poplin D	0.59	Cord weave	0.0074	3.90	2.60	+0.78	47	38	0.0182	0.0077
Tarantulle E	1.01	Plain weave	0.0046	1.80	1.04	1.16	120	133	0.0384	0.0041
Cambric H	0.49	Plain weave	0.0042	2.07	2.10	+1.56	103	105	0.0057	0.0056
Cambric I	0.29	Plain weave	0.0065	2.70	2.10	+3.90	88	89	0.0065	0.0066

The group of fabrics reported here, Table 1, included three broadcloths ranging in price from 80 cents to $1.36 a square yard, one poplin costing 59 cents a square yard, one Tarantulle at $1.01 a square yard, and two cambrics costing, respectively, 29 cents and 49 cents. The broadcloths and poplin were of cord weave; the Tarantulle and cambrics were plain weave. The cord-weave fabrics were thicker and more highly mercerized than the plain-weave fabrics. For both the cord- and plain-weave fabrics, there was great-

er shrinkage in the warp yarns than in the filling yarns. The lower priced fabrics in both cases showed stretching in the filling direction.

The weight and thickness of the fabrics appear to be closely related to price. The higher priced fabrics were finer and not as heavy as the lower priced fabrics.

Tarantulle (E) and broadcloth (B), representing the two types of construction, are both shirting fabrics costing the same per square yard. B showed the following qualities which might indicate that it is superior to E:

1. No shrinkage in the filling direction, as compared with 1.16 per cent shrinkage in E.
2. Less shrinkage in the warp direction.
3. Greater weight per square yard.
4. A more evenly balanced yarn count.
5. Greater thickness.

B was much stronger by breaking and bursting tests. Both showed uniformity of strength throughout the fabric, as well as a balanced thread count, although the thread count of E was about twice as high as that of B.

TABLE 2.—Breaking Strength of Some Cotton Fabrics

Fabric	Warp				Filling				Strength-weight factor
	Thread count	Breaking strength			Thread count	Breaking strength			
		X	Y	Z		X	Y	Z	
A	88				82				
Dry		88	8	9.09		31	6	19.35	42.3487
Wet		128	14	10.93		46	2	4.34	61.9217
B	76				70				
Dry		78	7	8.87		27	3	11.11	38.6029
Wet		141	4	2.83		43	9	20.90	67.6470
C	77				75				
Dry		119	13	10.92		30	4	10.33	50.5084
Wet		165	10	6.06		56	3	5.35	74.9152
D	47				38				
Dry		126	7	5.55		21	1	4.76	38.6923
Wet		196	13	6.60		32	3	9.37	59.4815
E	120				133				
Dry		30	5	1.66		19	3	16.30	27.2222
Wet		58	7	12.06		39	7	17.90	53.8888
H	103				105				
Dry		21	3	11.53		37	8	21.60	28.0193
Wet		48	4	8.30		46	4	8.69	45.4106
I	88				89				
Dry		38	5	13.16		47	3	6.38	31.4814
Wet		42	7	16.60		31	4	9.67	27.0370

Note: X represents "Resistance in pounds".
Y represents "Average deviation from average".
Z represents "Per cent deviation from average".

From Table 2 it may be seen that all of the fabrics were stronger when wet than when dry, except in the case of the 29-cent cambric, I, which showed slightly higher breaking strength in the filling direction when dry. There was no relationship between the thread count and the breaking strength of the fabrics. The best balance in thread count was found in the 80-cent broadcloth and in the 29-cent and 49-cent cambric.

The cord-weave fabrics exceeded the plain-weave fabrics in bursting and breaking strength but also showed greater deviation, indicating less uniformity of strength.

Of the three broadcloths studied, C, which cost the least, showed the greatest strength by breaking and bursting tests, the least deviation in strength, and a better balanced thread count.

Both of the cambrics studied were well balanced as to thread count, although H had a higher thread count. The breaking and bursting strength tests did not indicate that the 49-cent cambric was superior to the 29-cent cambric.

SUMMARY OF RESULTS

1. The rib-weave fabrics were heavier, thicker, and stronger than the plain-weave fabrics.
2. There was no relation between thread count and strength.
3. There was no relation between price and strength.
4. There was a relation between price, thickness, weight, and thread count in the fabrics studied.

FARM FORECLOSURES BY LIFE INSURANCE COMPANIES

F. L. MORISON

On January 1, 1930, the total farm mortgage debt in Ohio was estimated at $259,630,000. A survey recently completed by the Rural Economics Department showed that 28 life insurance companies held farm mortgages to the extent of $58,248,000 on that date, or about 22 per cent of the total. The farm mortgage holdings of these insurance companies have decreased in recent years, the amount loaned in Ohio on farm mortgages in 1931 being less than two-thirds as much as in 1928.

The average amount still to be paid on these mortgages was $5,147 on January 1, 1932, as compared with an average of $5,489 per mortgage on January 1, 1929. Individual mortgages run from 4 to 29 years; about 30 per cent of them are for 5 years, 29 per cent for 10 years, 26 per cent for 20 or 21 years, most of the remaining loans being for 7, 12, or 15 years. Rates of interest range from 4¾ to 7 per cent, the average being about 5½ per cent.

On January 1, 1932, 17 insurance companies owned a total of 731 farms in Ohio, totalling more than 110,000 acres. Ninety per cent of this land is in the western half of the State, with the greatest concentration in Paulding, Defiance, Union, Hardin, Madison, Putnam, Logan, and Highland Counties. In 1931, these insurance companies acquired 269 Ohio farms by foreclosure or by deed in place of foreclosure, as compared with 179 in 1929 and 58 in 1927. The total number of farms which these companies foreclosed on or acquired by deed in the 2 years 1930 and 1931 was about 4 per cent of the number on which they held mortgages January 1, 1930. Individual companies varied considerably in the ratio of foreclosures to mortgages.

Ninety-three of these foreclosed farms were reported as sold during 1931, at prices generally indicating a loss to the company. These sales undoubtedly have a depressing effect on the farm real estate market in western Ohio. Of the 731 farms to which these companies still retain title, 108 are being sold under land contract, with down payments ranging from $100 or $200 to one-fourth of the purchase price, and annual payments generally less than $500. Most of the remainder of the farms are operated by supervised tenants under a crop-share system of renting.

THE TREND OF FARM PRODUCT PRICES

J. I. FALCONER

That retail prices have declined at a slower rate than have farm prices or the wholsale prices of farm products is shown by the accompanying table. The farm product prices used are those reported by the United States Department of Agriculture. The wholesale prices and the retail food prices are those reported by the Bureau of Labor. The cost of living index is that compiled by the National Industrial Conference Board.

If the prices of May 1932 are compared with those for the year 1926, it will be found that prices at the farm have declined 60 per cent, prices on the wholesale market 54 per cent, while retail food prices have declined 37 per cent. The cost of living index, which, in addition to food, is made up of clothing, fuel, light, housing, and sundries, has declined 21 per cent.

Since the profits in food distribution, as reported in the earnings of large food-distributing companies, have also decreased, it would appear that distribution costs have not decreased in proportion to the cost of the raw material. Dr. G. F. Warren of Cornell reports a 17 per cent decrease in food distribution costs between the two periods. Of the major items in the cost of living, fuel and lighting have shown the smallest decrease, about 10 per cent; clothing, on the other hand, shows a decrease of one-third.

TABLE 1.—Trend of Prices

1913=100

	1913	1920	1922	1924	1926	1928	1929	1930	1931	Jan. 1932	May 1932
Farm product prices	100	205	125	134	136	139	138	117	80	63	56
Wholesale prices farm products	100	218	131	140	140	148	147	121	91	74	65
Retail food prices	100	203	142	146	160	154	157	147	121	109	101
Cost of living	104	212	168	170	176	171	172	167	151	140	134

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Price declines continued through May and June. From the middle of June to the middle of July, however, hog prices showed a 60 per cent rise. Beef cattle prices also advanced. Small grain prices, however, showed no evidence of advance as harvest approached. Industrial payroll totals in May were 42.5 per cent of the 1926 level.

Trend of Ohio Prices and Wages, 1910-1914=1910

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	99	100	101	102	102	102	105	107
1915........	102	101	106	100	103	107	106	110
1916........	125	114	123	117	113	113	121	121
1917........	172	129	150	176	140	119	182	198
1918........	192	160	178	200	175	131	203	243
1919........	202	185	205	209	204	135	218	266
1920........	225	222	206	205	236	159	212	242
1921........	142	203	156	116	164	134	132	136
1922........	141	197	152	125	145	124	127	136
1923........	147	214	153	135	166	122	134	149
1924........	143	218	154	134	165	118	133	150
1925........	151	223	159	146	165	110	159	164
1926........	146	229	156	136	170	105	155	176
1927........	139	231	154	131	173	99	147	163
1928........	141	232	156	139	169	96	154	147
1929........	139	236	155	138	169	94	151	161
1930........	126	226	146	117	154	90	128	130
1931........	107	207	129	80	120	82	89	93
1931								
January...	114	212	137	94	133	....	104	115
February..	112	215	136	90	....	....	96	85
March.....	111	219	134	91	....	82	98	104
April......	109	215	133	91	119	....	102	97
May.......	107	211	130	86	....	....	96	90
June.......	105	207	129	80	....	....	92	93
July.......	105	207	128	79	115	....	84	86
August....	105	207	127	75	....	....	86	90
September.	104	205	124	72	....	....	82	87
October....	103	199	122	68	116	....	77	86
November.	102	196	120	71	....	....	79	93
December..	100	194	119	66	....	....	72	88
1932								
January...	98	191	118	63	100	....	69	81
February..	97	189	116	60	....	....	64	68
March.....	96	189	114	61	....	70	64	67
April......	95	183	113	59	94	....	64	65
May.......	94	177	112	56	....	....	61	63
June.......	93	....	111	52	....	....	59	61

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 501. Fifty-year Index to Personnel and Publications of the Ohio Agricultural Experiment Station, by Charles E. Thorne. This index includes a complete list of the members of the Station's Board of Control, with their terms of service; members of the Station staff; a list of the Station's publications, except its press bulletins, with the title, number, and year of publication; and a subject index. The index was prepared at the fiftieth anniversary of the founding of the Ohio Experiment Station.

Bulletin 502. Preparation of Feeds for Dairy Cows, by C. C. Hayden, C. F. Monroe, and A. E. Perkins. Part I of this bulletin deals with the grinding of hay and stover; Part II deals with the mixing of ground hay and grains; and Part III deals with the grinding or chopping of roughages and fermenting, or "predigesting", them with "converters".

Copies of these bulletins may be obtained by addressing a request to the Mailing Room, Ohio Experiment Station, Wooster, Ohio.

NEW TECHNICAL BULLETIN NOT PREVIOUSLY ANNOUNCED

Technical Bulletin No. 9. Environmental Factors in Relation to Plant Disease and Injury: A Bibliography, by J. D. Wilson. This bibliography is an assembly of some of the papers in botanical literature which make reference to the influence of those environmental factors which are, in particular instances, either directly or indirectly harmful to plants. The environmental factors considered are listed in the index to the second section of this paper, and the scope of the diseases, injuries, and abnormalities dealt with is indicated in the third section.

The price of this bulletin is one dollar

The Bimonthly Bulletin

Nov.-Dec., 1932 Number 159

Ohio Agricultural Experiment Station

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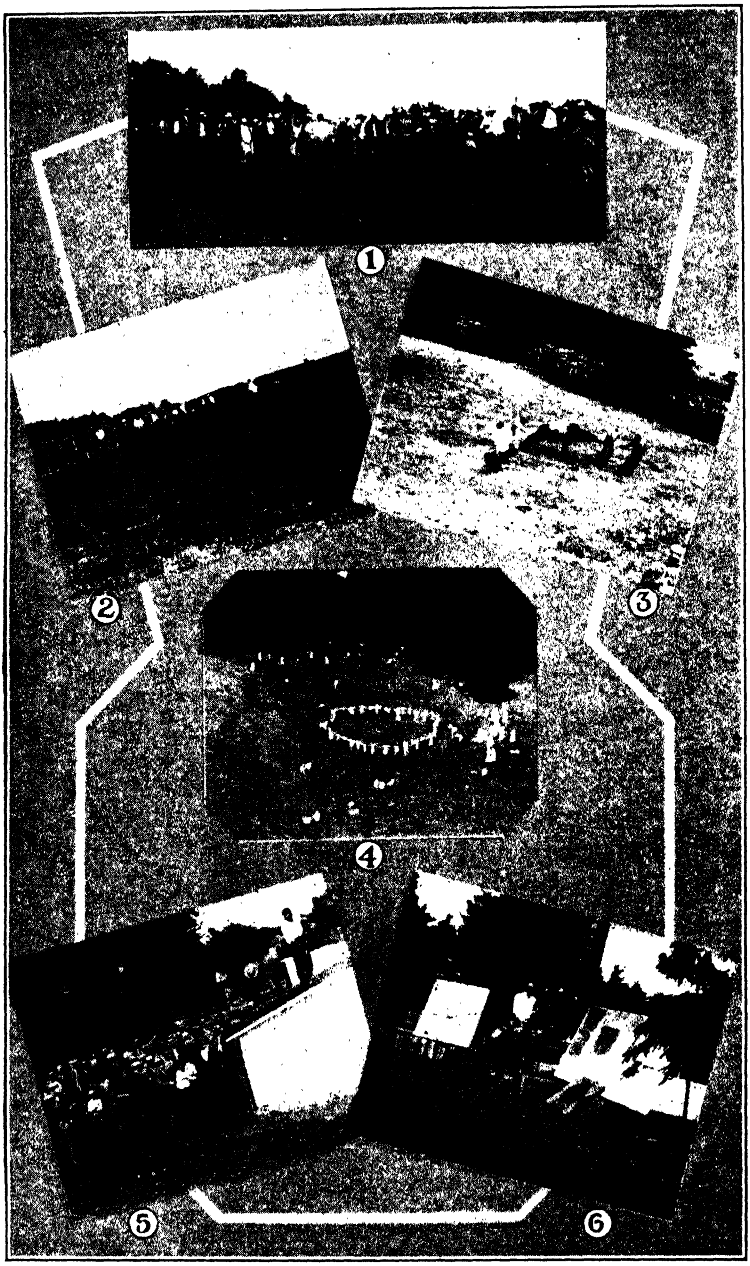
WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director



Scenes on Special Days at the Ohio Experiment Station

1. Forestry Day.
2. Corn and Soybean Day. 3. Dairy Day.
4. Activities of the Children on Special Days.
5. Poultry Day. 6. Orchard Day.

CONTROL OF FIRE BLIGHT BY TREATMENT OF CANKERS

R. C. THOMAS

The excellent results obtained with the chemical treatment of fire-blight cankers leads to the belief that such a practice will be a valuable aid in the control and eradication of the fire-blight disease of pears, apples, and quinces. Previous recommendations have emphasized the importance of cutting out blighted twigs and the removal of dead wood including cankers. Such a practice is being successfully followed by many orchardists. The degree of success which each one obtains depends upon the care and thoroughness with which the work is done.

Fire blight is a bacterial disease. The bacteria which cause it survive the dormant period in cankers or dead areas, particularly upon the larger limbs. With the opening of the growing season, small yellowish drops of liquid appear upon the surface of active cankers (Fig. 1). These drops of liquid are cultures of the fire-blight organism in an active and virulent state. Dispersal of these organisms is necessary before new infections can occur. This is accomplished chiefly by rain and insects, the latter being the more important. If insects could be completely eliminated, fire blight would cause little concern. It is more practical, however, to remove the sources of infection or, rather, to eradicate the fire-blight bacteria from an orchard.

Fig. 1.—Drops of bacterial exudate on surface of canker

Several years ago the California Experiment Station proposed, after successful trials, the application of a zinc chloride solution to blight infections. This solution penetrates rapidly to a sufficient extent to kill the bacteria but has little effect upon healthy tissue of pear trees if treatment is made soon after infection occurs. Properly disinfected cankers no longer give rise to drops of bacterial exudate and cease to be a source of infection in an orchard.

The zinc chloride solution was prepared by dissolving 9 pounds of dry zinc chloride in 1 quart of water to which were added 3 ounces of concentrated hydrochloric (muriatic) acid. An enameled kettle which had no cracks or breaks in the enamel was used. (The liquid may be heated to boiling to hasten solution). After cooling, the mixture was poured into 7 pints of denatured alcohol and mixed thoroughly. The mixture was then stored in tightly stoppered glass bottles to prevent evaporation. It will keep indefinitely and may be used as required.

Fig. 2.—Discoloration of tissue due to advance of infection

The acid - alcohol - zinc chloride mixture spreads and penetrates rapidly. Application may conveniently be made with a 1-inch or 1½-inch paint brush. The solution is strongly acid and may be used without inconvenience if ordinary precautions are observed. The alcohol-acid mixture is very painful to the eyes. If clothing becomes saturated and is allowed to remain in contact with one's skin for a time, irritation will result. This can readily be counteracted by applying a solution of washing soda or baking soda, it being well worth while to have such a solution available at all times. Paint brushes will last longer if placed in a soda solution after use. The acid mixture has little effect upon cotton and rubber goods although it does have an action upon leather and woolens.

Fire-blight infections should be treated as soon as possible. Where prompt attention is not given, it is commonly necessary to mar the appearance of a tree seriously in order to eradicate the blight. Often 4 to 5 years or longer are required to effect recovery. Terminal branches which are blighted should be cut away below the limit of infection (Fig. 2) and the stub treated. Applications of zinc chloride are of particular value in the case of cankers which have developed around diseased fruit spurs (Fig. 3) or water sprouts. There is much advantage in leaving the dead wood of a canker in place, because the strength of a limb is not reduced as is the case where deep seated cankers are cut out. The rough, outer bark should be removed from old cankers before the solution is applied.

The zinc chloride treatment may be made at any time of the year. Best results are obtained when the trees are dry, due to the fact that penetration is most rapid and the solution is undiluted. Cankers can be most easily detected during the dormant season after the leaves have fallen. In the spring, after growth starts, occasional inspection of the treated cankers is well worth while to determine if they have been thoroughly sterilized. If the margin has extended, another application is necessary; usually one application is sufficient.

Fig. 3.—Infected blossom clusters

The method of treatment given for the control of fire blight cannot be depended upon for the sterilization of other forms of cankers, such as are associated with black rot, bitter rot, or blister canker of apples. Probably, the mycelium penetrates too deeply for the treatment to be effective. It has been observed, however, that treated fire-blight cankers are not likely to become invaded with the black rot fungus; whereas untreated cankers are very likely to be. The zinc chloride treatment has given promising results upon blotch cankers, but further work will be required to determine the strength of solution which will be most effective and safe to use upon apple trees. It appears, however, that a weaker solution, containing 4½ pounds of zinc chloride instead of 9 pounds as recommended for pears, will be satisfactory.

THE USE OF FORMALDEHYDE DUST IN GROWING CELERY SEEDLINGS

J. D. WILSON

Large percentages of the celery seedlings grown for the early crop in Ohio are lost each year from damping-off, root rots, or nematodes. Most of these seedlings are grown in ground beds in specially constructed sash houses, but more and more of them are being grown in elevated or ground beds in small greenhouses. Houses of the latter type usually possess better facilities for ventilation and temperature control than the former. The sash houses are from 12 to 16 feet wide and heated by a small stove in one end. The pipe from this stove runs the length of the house just beneath the ridge. Ventilation is obtained through doors located at each end of the house. The beds in which the seedlings are grown are located on the ground along each side of the house and a narrow walk is left through the middle in most instances.

The soil used in these beds may or may not be replaced each year. If it is to be replaced, the soil is brought in from the field in the fall and stored in piles until used in February. Instead of sowing dry seeds over the tops of the prepared beds and covering them with a little soil as is frequently done for the later crop, the seeds used for the early crop are first sprouted and then sown. About February 10, the desired quantity of seeds is placed in a small pan, together with two or three cupfuls of finely divided muck soil, and there allowed to remain in a warm, moist condition until small sprouts about 1/8 to 1/4 of an inch long have developed. This mixture of soil and seeds is then scattered over the surface of the beds, covered very thinly with additional soil, and watered.

There are certain precautions which must be observed in growing any type of seedlings to keep losses from damping-off and similar troubles at a minimum. Soil should be used which is as "disease-free" as is obtainable. The beds should be watered heavily at long intervals rather than lightly at short intervals. Applications of water made on clear, dry mornings are to be preferred to those made on cloudy, damp ones since diseases of the damping-off type are most destructive under conditions of low light and high humidity. Good ventilation over the beds and around the plants is essential. Plantings should not be too thick, and to aid in drying the soil surface a thin layer of sand may be used on the beds. Also, as much light as possible should be allowed to fall on the beds.

If losses are still severe in spite of these precautionary measures to avoid them, the use of chemical or heat sterilization of the soil to be used in the beds must be resorted to. Steam or hot water sterilization is often impractical. Success attained by other investigators at this Station in growing seedlings of various kinds after treating the soil with formaldehyde dust (commercial formalin adsorbed on some carrier like charcoal or infusorial earth) suggested its use in the culture of celery.

Preliminary tests were made to determine the amount of the dust which it would be practical to use per square foot of bed area and the time which should be allowed to elapse before sowing the seed in order that injury due to the presence of formaldehyde might be avoided. Previous experiments had shown that seedlings of various kinds transplanted in soil recently treated with formaldehyde dust were injured if any free formaldehyde still remained in the soil. Since sprouted celery seeds are in reality miniature seedlings and thus very susceptible to unfavorable environmental influences, it was very important that sufficient time be allowed after treatment and before planting for the soil to be freed of formaldehyde if stunting, or even actual death, were to be avoided.

In an experiment to determine the time which must be allowed to elapse before sprouted seeds could be sown in formaldehyde-treated muck soils without injury resulting, a quantity of soil was obtained from a field which had grown celery for several years. A portion of this was sterilized in an autoclave at 20 pounds steam pressure for 4 hours for use in check flats in this and various other tests to be made later. Flats 4 inches deep were used to simulate the conditions of commercial practice as closely as possible. The soil was treated with 12 ounces of a 6 per cent formaldehyde dust (15 per cent by weight of commercial formalin) per bushel. Treatments were made 72, 48, 24, 12, 6, and 0 hours before planting the seeds. This plan made it possible to plant all of the flats at once and from the same lot of seed. Each flat was watered as soon as the treated soil had been placed in it. The sprouted seeds were scattered over the soil and raked in lightly; then the whole series was watered thoroughly again.

Figure 1 shows the amount of growth which had taken place in each flat after a period of 25 days. Flat 1 is the check in steam-sterilized soil, untreated with formalin; Flat 2 was planted immediately after treatment; Flat 3 after 6 hours; Flat 4 after 12 hours; Flat 5 after 24 hours; Flat 6 after 48 hours; and Flat 7 after 72 hours. The plants in Flat 7 are as large as those in the check flat

and those in Flat 6 are nearly as good; all the others are markedly smaller, and in Flats 2 and 3 they are fewer in number. This smaller number was due to a killing of the sprouted seeds by the formaldehyde at the time of planting. The partial stunting of the plants in Flat 5 indicates that some formaldehyde was still present in the soil 24 hours after treatment and that at least 2 days should be allowed to elapse after treatment before planting sprouted seeds and that an interval of 3 days is even better.

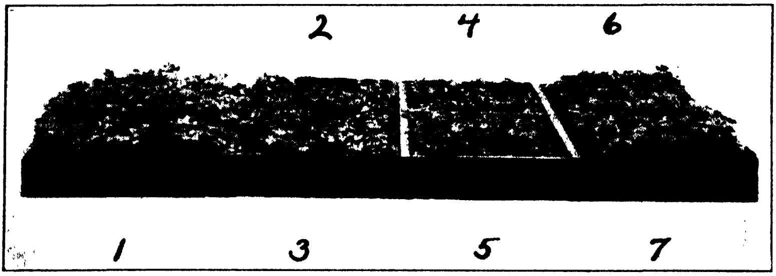


Fig. 1.—Influence of residual formaldehyde when sprouted celery seeds are sown in recently treated soil

If loam soils are used for starting the seedlings, about 8 ounces of dust per bushel of soil should be used and at least 72 hours should be allowed to elapse between treatment and the sowing of sprouted seeds or the transplanting of seedlings. Similar experiments with unsprouted seeds showed that germination is not affected if the seeds are sown 6 hours after soil treatment.

An experiment to test the efficacy of formaldehyde dust in controlling damping-off was carried out, in which soil was obtained from six different growers. One-half of each lot of soil was treated with dust at the rate of 12 ounces per bushel (2.4 ounces per square foot in 3-inch depth) and placed in a greenhouse bench. All 12 sections were then planted with unsprouted seeds and watered immediately. The long period required for the germination of celery seed (14 days in this case) makes this a severe test of any soil sterilizing treatment because of the chance for re-contamination. No differences between the treated and untreated sections could be observed in two soils in which the untreated sections were excellent. In two others the differences were minor in nature, but in the remaining two they were very marked. In the last two the plants in the untreated sections did not come up as thickly and did not grow as well later as they did in the treated sections. The relative size of the plants in the two sections 5 weeks after planting

may be seen in Figure 2, in which A is the treated section and B the untreated. Damping-off, which began immediately after seedling emergence in four of the untreated sections, had become severe enough to leave blanks in some of the rows at the time this photograph was taken. The results indicate that, in those cases in which the soil is contaminated with organisms capable of causing seedling diseases (chiefly *Pythium* spp. and *Rhizoctonia* spp.), treatment with formaldehyde dust should be worth while but that, if good plants can be grown without treatment, little improvement may be expected.

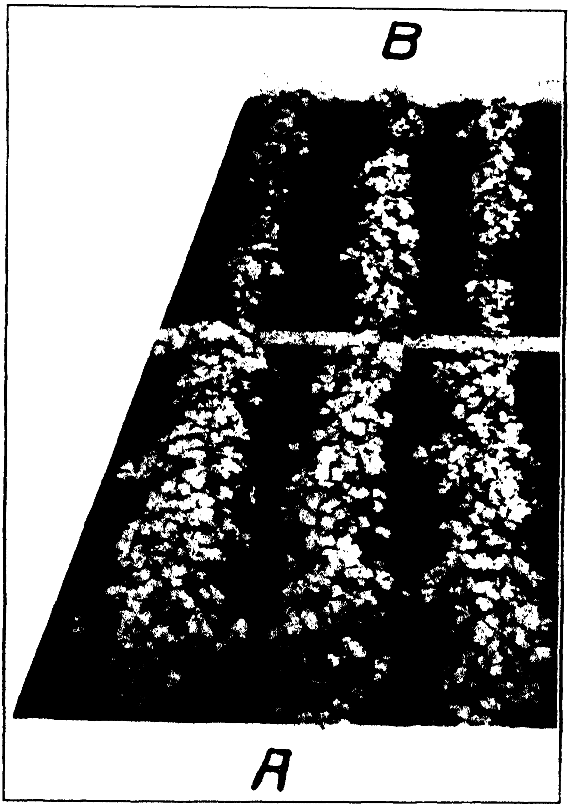


Fig. 2.—Comparison of plant size and density of stand in treated (A) and untreated (B) flats

Figure 3 shows plants from commercial beds. The plant on the right was grown in a bed treated at the rate of 3 ounces per square foot of surface area. The formaldehyde dust was spread on the top of the soil as evenly as possible and then the bed was thoroughly worked over with a hoe and rake to a depth of about 4

inches. The soil was at a medium moisture content before mixing and was well watered immediately afterward. Three days after treatment sprouted seeds were sown in the beds and water again applied. The plants in this bed grew well and evenly, and damping-off was very scarce. Note the large root system. The plant on the left was grown in soil from the same lot as the one on the right but was not treated with formaldehyde dust. The root systems of nearly all of the plants in this bed were small and many of the rootlets were brown and broke off very easily. Damping-off occurred in several spots in the bed. The plant in the center was grown in untreated soil infested with nematodes (*Heterodera radicicola* [Greef] Müll.). Ninety per cent of the seedlings was affected by the time they had reached this size, and the tops were stunted and the stand uneven in density and size. Beds made up of soil from the lot containing nematodes but treated with formaldehyde dust at the rate of 3 ounces per square foot produced plants similar to the one shown on the right, except that approximately 10 per cent of them was affected with nematode galls.

Fig. 3.—Improved root growth of celery seedlings in treated soil (extreme right) as compared with check plants showing root rot (extreme left) and nematode infection (center).

The results obtained in the commercial beds mentioned above indicated the necessity of determining, if possible, the minimum quantity of formaldehyde dust which would give a practical control of nematodes on celery seedlings when grown in muck soils. These plants are always removed from the soil when small, and, therefore, the period over which infestation may occur is comparatively short

after germination. If plants can be grown which are free, or nearly free, from these galls at the time they are transplanted, they should begin growth quickly in the field, and grow more rapidly, and finally become larger than those subject to the root pruning which accompanies nematode infestation. Also, the chances of distributing the nematodes about the field are much less.

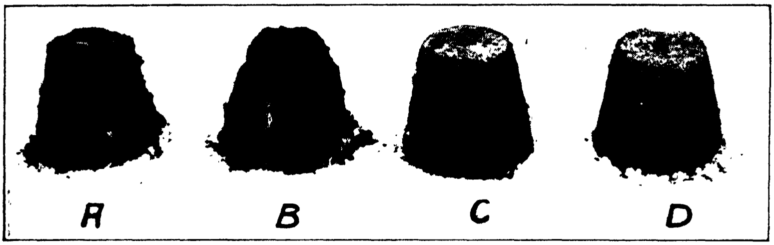


Fig. 4.—Influence of formaldehyde dust in checking nematode infestation and improving root growth, A (No treatment), B (4 oz. per bu.), C (16 oz.), and D (32 oz.)

A quantity of nematode-infested soil was screened to remove large roots and galls and then divided into lots sufficient to fill a series of 8-inch pots. This removal of large galls and soil masses is necessary since the formaldehyde cannot penetrate sufficiently to kill nematodes which may be present in them. Treatments were then made ranging at intervals of 4 ounces from 4 to 32 ounces per bushel. These variously treated soils were then put in the pots, unsprouted seeds sown, and water applied immediately afterward. Figure 4 shows the root growth in some of the treatments after a period of 6 weeks. The soil mass A was untreated, B was treated at the rate of 8 ounces of 6 per cent formaldehyde dust per bushel of soil, C with 16 ounces, and D with 32 ounces. Other intervals in the series, such as 4, 12, 20, 24, and 28 ounces per bushel, are not shown. It may be noted that the root growth is best in the soil treated at the rate of 16 ounces; also, this treatment was the best of the whole series when the size and number of plants obtained were considered. Treatments below 16 ounces of dust per bushel did not give control of the nematodes (there were a few galls at 12) while those above 16 caused some stunting of the seedlings.

CONCLUSIONS AND RECOMMENDATIONS

Soil to be used for growing celery seedlings should be treated, if trouble has been experienced in getting good plants due to damping-off or to poor root systems, if soils on which celery has been grown previously are used, or if nematodes are likely to be present.

The formaldehyde dust may be mixed with the soil and the mixture placed in the bed, or the bed may be prepared and the dust spread on the top of the soil and quickly worked in to a depth of 3 to 4 inches.

Celery seedlings cannot be safely transplanted into muck soil treated with formaldehyde dust until a period of 48 hours after treatment has elapsed, and one of 72 hours is still better. The necessity of this interval to allow the escape of the formaldehyde is even more imperative in the case of mineral soils.

Since sprouted celery seeds are in reality miniature seedlings, 72 hours should elapse between soil treatment and sowing. Twelve ounces of a 6 per cent formaldehyde dust should be used for each bushel of soil. Since one bushel constitutes a mass one foot square and approximately 15 inches deep, the following formula may be used to translate ounces per bushel to ounces per square foot of bed area, the bed being of any given depth:

$$\frac{\text{Ounces per bushel} \times \text{bed depth in inches}}{15} = \text{Ounces per square foot}$$

If nematodes are suspected of being present in the soil, it should be screened to remove all large roots, lumps, etc., and then treated with a 6 per cent formaldehyde dust at the rate of 16 ounces per bushel. This will not completely eradicate the nematodes, but the infestation will be greatly reduced.

THE ABERDEEN AND WASHINGTON STRAWBERRY VARIETIES

J. S. SHOEMAKER

The Aberdeen and Washington strawberry varieties were prominent in the test plots at Wooster in 1932. One of these varieties, the Aberdeen, showed some promise of value for Ohio conditions. The other variety, the Washington, was prominent for reasons which are given later.

THE ABERDEEN STRAWBERRY

Conditions under which strawberries are grown and marketed, as well as personal preferences, vary so greatly that any one variety is differently rated by various growers and consumers as to its desirability. The characteristics of Aberdeen which are listed in this brief article have been gathered from 3 years' observation of its behavior at the Ohio Experiment Station. In 1930, 1931, and 1932 the Aberdeen planting in fruiting consisted of 37½, 75, and 745 feet of row, respectively.

TABLE 1.—Comparison of Ripening Dates and Yield of Premier and Aberdeen Strawberry Varieties at Wooster in 1932. First Crop. (745 Feet of Row for Each Variety). Yield in Quarts

June	6	8	10	13	14	15	16	17	18	20	21	22	24	Total
Premier	3.4	7.4	19.5	81.9	.....	62.2	......	82.9	.....	92.8	......	21.1	.....	371.2
Aberdeen	.....	...	0.1	....	7.5	...	31.7	.....	64.0	.	109.0	40.0	36.0*	288.3

*At least one more picking, possibly two more, should rightfully be credited to Aberdeen. After June 24, the pickers were urgently needed for other work. It seemed improbable, even with one or more additional pickings, that the total yield of Aberdeen would equal that of Premier for the season.

The yield and size of strawberries is considerably reduced by drouth. Fortunately, in 1932, a heavy mulch (at the rate of about 5 tons of clean wheat straw per acre) helped to maintain moisture much better in the planting at Wooster than in the one where less material or weedy mulch material was applied. Late in the Premier season, several heavy rains occurred. These benefited the Aberdeen more than they did the Premier, but in other years the rains may, of course, occur at a time when they would benefit the latter more than the former variety.

The desirable characteristics of Aberdeen are: (1) It is a prolific maker of thrifty plants. (It makes many more plants than Premier. The foliage is dark bluish-green and more glossy than that of Premier). (2) It is more highly productive than any other variety tested at Wooster which extends the Premier season. (3) It blooms slightly later than Premier, enabling it to escape frosts in some years. (4) In the later part of the season, the berries are larger than those of Premier. (5) Externally, the berries are light red in color and are attractive in boxes. The sound berries maintain a pleasing color in the store better than do dark colored ones, such as those of Parsons (Gibson). (6) Some like its flavor better than that of Premier, their reaction being that it is more typically "strawberry flavored". (7) Jam or preserves made from the berries is light red in color. (8) The blossom is staminate.

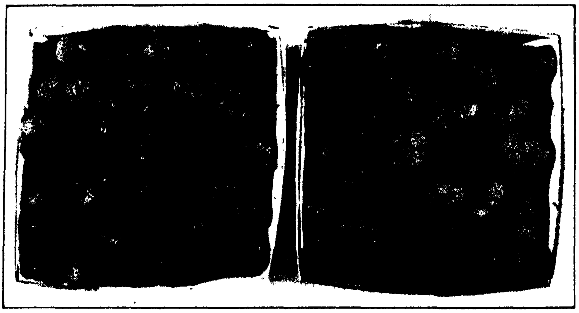


Fig. 1.—Comparative size of Premier (left) at the eighth picking and of Aberdeen (right) on the same day

Some objections to the Aberdeen are listed as follows: (1) The berry is rather soft and easily bruised. (2) The berry is somewhat acid, especially in the first pickings. (3) The tip of the berry is inclined to be whitish in color. (4) The core of the berry is whitish. (5) The berries are none too uniform in size, and many of them are rather small. (6) A darker berry is preferred for canning. (7) It may be too prolific a plant maker under some conditions. (8) Its yield for the season, although higher than that of other varieties ripening at the same time, is less than that of Premier. (9) The fact that it ripens somewhat later than Premier may not always be an advantage, because the price may be comparatively low at that time.

The Aberdeen is not recommended to replace Premier. Aberdeen seems worthy of trial to supplement Premier, where berries are sold to local trade and where larger and more attractive berries

are desired late in the Premier season. The softness of its fruit may prove, in some cases at least, a serious drawback in hauling the fruit to market. Aberdeen undoubtedly is not a suitable variety for all Ohio growers. It may find favor with some, and this is the chief purpose in bringing it to attention here.

THE WASHINGTON STRAWBERRY

The Washington strawberry variety proved the most disappointing of all those fruiting in 1932 at the Ohio Experiment Station. This fact is recorded here since a number of growers have considered planting fairly extensive acreages of the Washington variety. This variety, due to leafspot diseases and possibly to other diseases, showed a very sparse leaf growth at fruiting time in 1932. These diseases were negligible on other varieties nearby. Although Washington showed indications of being remarkably sweet, the sparse leaf growth prevented the development of good flavor. In fact, the first crop of Washington (50 parent plants, in two different plots) was practically worthless in 1932. The experience of a number of growers in the State who fruited Washington in 1932 confirms that at the Ohio Experiment Station. Some of these growers were well pleased with the behavior of Washington in 1931. The condition of the Washington plants that prevailed in 1932 may not occur every year, and, in fact, some plantings of the variety in Ohio were thrifty in 1932. The possibility of the recurrence of the disease condition in occasional years, however, would seem sufficient to discourage extensive planting of this variety.

NEWER DEVELOPMENTS REGARDING SILOS AND SILAGE

A. E. PERKINS

Silos were introduced into this country during the eighties and nineties of the past century. Many of the styles in buildings, in clothing, in heating and lighting equipment, in transportation, and in many other phases of life which were then in vogue are now of little or no interest outside a museum.

It seems logical to inquire, therefore, whether the silo is ready to be replaced by other equipment which is either more convenient and economical or which offers a more efficient system of feed preservation and storage than does the silo. The briefest survey will

show us that, instead of going out of use, the silo has been steadily gaining in favor and in the number of units in use. Prof. A. L. Haecker, who has made a study of this subject, placed the number of silos in use in the United States in 1929 as 483,265. Ohio ranked eighth among the states in this respect. The silo appears to be a permanent institution rather than merely a passing style. Like most other enduring institutions, however, the silo has undergone many changes and improvements. The first silos built were either square or rectangular in form and were for the most part located inside other buildings. This method of construction invited trouble in the way of walls bulging at the center of each side because of the great weight and pressure of the silage. Spoilage of the contents often resulted.

IMPROVEMENTS IN SILOS AND FILLING MACHINERY

The cylindrical, stave and hoop silos which were soon introduced overcame this difficulty and did much to eliminate the excessive losses which commonly occurred in the first silos. The location of the silo out-of-doors has done away with the useless expense of a double enclosure of the space within the silo and has also made the silo more accessible for filling. A great variety of building materials has been used in silo construction. A smooth, tight, strong, and enduring wall is needed. The material which satisfactorily fulfills these conditions and can be had most advantageously in the particular locality is probably the best for the man wanting a silo.

There has likewise been great development in the convenience and efficiency of the machinery used in cutting and loading the corn in the field—from hand-cutting and loading to the binder with loader attached, or the combination which chops the corn ready for the silo in the field as fast as it is cut. The machinery for cutting and elevating the corn at the silo has likewise seen developments of great importance, including the fan elevator and the sectional, flexible distributor.

One objection to the use of the silo has been the difficulty of assembling and organizing the work of the large crew of 15 to 20 men necessary to keep the large commercial, silo-filling outfits in continuous operation. Also, the silo filled rapidly and not refilled is usually little more than two-thirds full when the silage has settled. In recent years power from either the gasoline tractor or the electric current is available on a large percentage of farms.

Either of these may be used satisfactorily to furnish power for silo-filling. By using these sources of power and smaller home- or group-owned cutters it is now practical to fill the silo more slowly, using a much smaller crew than is required to operate the large commercial machines. As few as two or three men may fill a silo, if desirable.

The silage will usually be packed better after the slower filling. The full capacity of the silo will also be much more nearly utilized. This system also makes it more feasible to ensile smaller amounts of other crops whenever they may become available, a practice which will be discussed later.

SILAGE AS A FEED

Whatever the improvements in economy and convenience which have been effected in the matter of making and handling silage, the real test of the merits of silage lies in its effect on the animals and its efficiency as a feed. Silage has been generally recognized as a feed having great merits for the dairy cow. Cows which receive silage seldom develop the constipated and hidebound condition common among dry-fed cows in late winter and spring. Silage, however, has had its opponents who have regarded it as detrimental chiefly because of its high acid content and who have claimed that it produced acidosis. This question has been thoroughly studied at the Ohio Station during the past 2 or 3 years. Fifty pounds per day of silage have been fed for several months. Some cows have been fed exclusively on silage, and others have been fed more lactic and acetic acids in pure form for considerable periods than a cow would ever get from eating silage. As shown by careful studies of the blood and urine of these cows, there was not a sign of any harmful effect. Apparently, the silage acids, which are derived from the fermentation of sugars, are used for food as readily as are the sugars themselves. Exclusive grain feeding, on the other hand, produced marked evidence of acidosis during a 3-week period when it was practiced. Consequently, the beneficial effects of silage feeding may be had without fear of any harmful effect on the animal, except such as may come from over-doing any good thing.

The other line of attack against the silo is that it is wasteful, because of losses due to fermentation or spoilage. The proportion of the dry matter of corn lost by fermentation during silage-making ranges between 5 and 10 per cent, as observed by different workers.

Additional loss is encountered at the surface of the silo, unless feeding is begun at once after filling. These surface losses may be largely prevented by covering the surface with less valuable material, such as weeds or stover silage, corn from which the ears have been removed, or by covering the surface with roofing paper and then with sand or sawdust.

It was observed at the Missouri Experiment Station that corn cured in the field, even when the shocks were screened-in to protect them from birds and mice, lost more from weathering, leaching, and the breaking of leaves than the average loss which occurs in the silo. If the loss from birds and rodents were also included, the silo would have been by far the least wasteful method of handling the corn.

Silage has been used and appreciated by the dairyman perhaps more than by the owners of any other class of livestock; yet, for the most outstanding comparison between the feeding value of an acre of corn when made into silage and an equal acre when fed as ground, shock-cured corn, we must borrow from the work of the steer feeder. Four comparisons of this kind have been made at the Madison County Experiment Farm of this Station. The gains from an acre of corn silage have proved to be 1.8 times as valuable as those from an acre of ground fodder. At the Kansas Experiment Station a value 1.63 times as great for the silage as for the fodder corn was obtained in a similar experiment. The additional cost of preparing the acre of ground fodder, which amounted to $10 per acre in the Ohio work, was not included in either comparison.

Few comparisons of this nature with dairy cows are available, and in those which have been made the results have not been so strikingly in favor of the silage feeding as the above-mentioned experiments with steers would indicate. Five experiments of this kind in which silage was compared with whole fodder corn are cited and summarized by Henry and Morrison. They show an average superiority in milk production of approximately 8 per cent on the total dry matter basis in favor of silage. An experiment conducted in the early days of this Station comparing a heavy silage ration with one containing corn stover and a heavy feeding of grain showed a substantially greater production per pound of digestible nutrients in the case of the silage ration. A recent experiment reported from the South Carolina Experiment Station seemed to show that under their conditions silage and ground fodder corn were practically equal on a dry matter basis.

Why there should be so much greater difference between these feeds in the case of steers than in the case of dairy cows is hard to explain on the basis of any data known to us.

Probably the fact that in most of the dairy experiments the silage and fodder have been fed in smaller amounts and in addition to an otherwise good ration of hay and grain has minimized the existing differences between these feeds.

In the Ohio experiment with steers, at least part of the advantage to the silage group lay in the superior bloom, or condition, which they possessed. In a dairy experiment, especially one of short duration (and this includes most of the ones reported), such an effect might not show up in the form of milk production. Evidently, further work is needed to explain such great differences in results.

CROPS WHICH MAY BE SUCCESSFULLY ENSILED

In Table 1 is shown a list of crops which have frequently been reported as making good silage under proper conditions. The list is by no means complete but includes most of the crops in which the Ohio farmer is likely to be interested for this purpose. Corn rightly holds first place as a silage crop in most sections of Ohio, and, as a rule, a large-growing variety of field corn, which will mature or nearly so in the average season, will yield the maximum return. Leaming or Reid's Yellow Dent are suggested as suitable varieties, although others may be equally satisfactory. In some sections relatively unfavorable for corn growing and capable of producing abundant yields of grass or of the small grains at less expense, these crops may easily rival corn as a desirable material for silage.

TABLE 1.—Some Crops Which May be Successfully Ensiled

Corn, entire plant	Wheat
Corn, ears only	Rye
Corn, green stover	Barley
Corn, dry stover, and water or some green crop	Soybeans
Corn, cannery refuse	Clover
Oats, oats and peas	Sweet clover
Peas, cannery refuse	Alfalfa
Sorghums	Grasses
Apple pomace	Sunflowers
Cull potatoes, apples, or beet-tops, in connection with hay, straw, or stover	Weeds

The silo also offers a convenient and valuable means of saving other crops in emergency. A crop of wheat or oats which is weedy or which is lodged so that the grain is likely to be damaged will still make excellent silage. Crops which were intended for hay but

which can not be successfully cured because of unfavorable weather may often be saved in the silo. Silage made in this way in early summer is the best form of insurance against the disastrous milk shrinkages which often result from insufficient feeding when the pastures fail because of dry weather or other causes. The silo may in this way be made to do double duty at no extra cost.

In Table 2 will be found a summary of the best recommended practices regarding the time of ensiling various crops so far as they are known. In general, corn, the grasses, and the cereal grain crops seem to make the best silage when the plant is still rather high in moisture, a dry matter content of 25 to 35 per cent seeming to be about the optimum amount.

TABLE 2.—Proper Stage of Maturity for Ensiling

Corn	Ears glazed and dented. Leaves and stalk still green. Dry matter content— 20–40 per cent satisfactory. 25–35 per cent preferred.
Small cereal grains, oats, wheat, and rye	From late milk to dough stage of grains.
Soybeans	Seeds well formed but not ripe. Leaves coloring.
Sweet clover, alfalfa, clover	Medium-late bloom stage. If very green, allow to wilt in the swath several hours. Dry matter content between 40 and 50 per cent.
Grasses	Early haying stage.

The leguminous crops like soybeans, alfalfa, clover, sweet clover, and cow peas, on the other hand, have been shown to produce the best quality of silage at a dry matter content of 40 to 50 per cent. If the crop must be cut in a green condition, the higher dry matter content can be attained by partly drying the crop before ensiling.

MIXTURES OF CROPS FOR SILAGE MAKING

Often a mixture of two or more crops will make a more satisfactory silage than either alone. Clover, alfalfa, soybeans, sweet clover, peas, or other legumes are often ensiled alone and usually make a silage of fair palatability which is particularly valuable for its high protein content if the crops are in the right condition when ensiled. Leguminous crops which are too green or too high in moisture may make bad-flavored silage of poor keeping quality. Mixing corn or one of the other cereals with a leguminous crop will usually produce a more palatable silage of better keeping quality than will the legume alone. By mixing one load of partly dried soybeans with from two to three loads of green corn at the silo an

excellent quality of silage which contained practically twice as much protein as did straight corn silage has frequently been secured at this Station. If such silage is fed, especially when used in connection with legume hay, the ration will contain an abundance of protein without the use of high protein products in the grain mixture.

A green crop of high moisture content, such as green rye, green oats, beet tops, or sunflowers or cull potatoes or apples may also be mixed with corn stover when it is desired to convert the stover into silage. In such cases, the green crop will supply the needed water, as well as the fermentable sugar needed to make good silage. Corn stover was ensiled in this way along with a volunteer crop of green oats at this Station in November, 1931. The resulting silage, although not equal to the best silage made from well grained corn, was still of excellent quality and palatability and far superior to stover silage made by wetting with water. One pound of field-dried stover to each 3 or 4 pounds of the green material gives the mixture about the proper dry matter content for good silage. Proper planning in advance would enable one to provide a frost-resistant green crop to ensile with stover or other dry crop at any given time in either fall or spring.

SILAGE MAY BE MOVED

While, as is generally known, air leaks in the silo must be scrupulously avoided and silage exposed to the air soon spoils, it has been demonstrated at this Station that silage can be successfully moved and re-ensiled when necessary or desirable to do so. The contents of a wooden silo which was burned so that it collapsed were moved a distance of 2 miles and stored in another silo. On another occasion, the contents of a silo were bought and trucked to the Station, a distance of 12 miles. The silage in each case was elevated into the silo by means of a silage-cutter having a fan-type elevator, the knives being removed. The quality of the silage did not noticeably deteriorate in either case.

PIT AND TRENCH SILOS

In some parts of the country, more particularly the Northwestern Plains Area, few of the tower-type silos with which we are familiar here in Ohio are found, but instead the pit or, more recently, the trench silo seems to predominate. This consists of a trench perhaps 12 feet wide at the top, 8 feet wide at the bottom, 8 feet deep, and as long as desired. It must be located on well drained ground. The sides and ends are sloped to avoid caving. The

silage may be packed by driving over it with team or tractor. The silage is heaped or rounded up in the trench and is often covered with wet straw and soil.

Feeding is begun from one end of the trench and proceeds gradually to the other. Some sort of reinforcement for the side walls and some kind of roof are desirable and almost necessary if the same trench is to be used as a silo from year to year. So far as we know, the trench silo has not been used to any extent in Ohio. In our opinion it is much in the nature of an emergency measure and would probably be less satisfactory than the customary tower silo where the latter can be provided, although it might be used to advantage under some conditions.

THE SILO IS NOT A MYSTICAL OR MAGICAL INSTITUTION

Whatever the silo may be, it is certainly not, and its advocates do not claim it tc be, a magic-box into which more or less worthless or inferior material may be placed and transformed into high class feed. The silo represents merely a system by which various kinds of fresh or green feed may be stored and preserved with little loss or change for future use at any desired time. This is also accomplished with a minimum of labor. Often the resulting product is much more palatable than the same material preserved by drying. Crops can often be handled to advantage in the silo when weather conditions make preservation by drying impossible, and, furthermore, approximately twice as many pounds of dry matter can be stored per cubic foot of space in the silo as can be done in the case of the uncut dry roughage.

In conclusion, the economy, efficiency, and desirability of the silo have been studied and demonstrated under both scientific and practical conditions for many years. During this time many improvements have been made and the range of usefulness of the silo greatly extended. There seems little prospect or possibility that the silo will soon be replaced by any other system of feed preparation.

FATTENING STEER CALVES

PAUL GERLAUGH

Previous work on the feeding of molasses to steer calves is reported in Bulletin 463 and Bimonthly Bulletin 154 of this Station.

In the 1931-1932 test all five lots were fed 7 pounds of corn silage and 1½ pounds of mixed clover and timothy hay daily per calf. Lots 1, 2, and 3 were fed 2 pounds of protein supplement daily per calf. This protein supplement was equal parts of linseed meal and cottonseed meal.

Lot 1 was full-fed shelled corn.

Lot 2 was fed ½ pound of cane molasses and full-fed shelled corn.

Lot 3 was fed 1 pound of cane molasses and full-fed shelled corn.

Lot 4 was fed similarly to Lot 1, excepting that 1 pound of protein supplement was withdrawn from the ration and 1 pound of shelled corn added.

Lot 5 was fed a protein supplement containing equal parts linseed meal, cottonseed meal, and dry rendered tankage and fed in such amount as to equal the protein content of the mixture fed to Lot 1. Because of the high protein content of the tankage, 1.55 pounds of this supplement contained as much protein as 2 pounds of the supplement fed to Lot 1. The amount of shelled corn fed to Lot 5 was the same as that fed to Lot 1.

The calves used in the test were from the Panhandle Region of Texas. They weighed 383 pounds in Texas, October 17, and 357 pounds off the cars in Wooster, October 22. There was no serious sickness apparent in the calves due to their shipment.

The calves were allotted by listing them in the order of their weight and placing Numbers 1, 10, 11, 20, etc., in Group 1; Numbers 2, 9, 12, 19, etc., in Group 2; Numbers 3, 8, 13, 18, etc., in Group 3; Numbers 4, 7, 14, 17, etc., in Group 4; and Numbers 5, 6, 15, 16, etc., in Group 5. This arrangement gave the starting weights shown in the table, and the several men who saw the groups could not notice any apparent difference in quality. The groups were then assigned to their respective lots by chance drawing of lot numbers.

Molasses increased feed consumption and average daily gain. Lot 2 outgained Lot 1 an average of 47 pounds per calf. The men from the various markets did not think that Lot 2 was any fatter

than Lot 1. Lot 2 had grown more. Lot 3 outgained Lot 1 by 70 pounds per steer. These steers were fatter than Lot 1 in the opinion of most men but were also growthier in their appearance.

TABLE 1.—Steer Feeding Test

Experiment 678

From November 10, 1931 to August 16, 1932	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Number steers per lot	20	20	20*	20*	20
Cost per cwt. in feed lot	$ 8.00	$ 8.00	$ 8.00	$ 8.00	$ 8.00
Average weight, November 10, 1931, lb.	394.00	394.00	394.00	396.00	393.00
Average weight, August 16, 1932, lb.	898.00	945.00	968.00	897.00	937.00
Average daily gain, 280 days, lb	1.80	1.97	2.06	1.78	1.94
Average ration:					
Shelled corn, lb	9.08	9.89	9.71	10.13	9.14
Protein supplement†, lb	2.00	2.00	2.00	1.00	1.58
Silage, lb	7.00	7.00	7.00	7.00	7.00
Mixed hay, lb	1.50	1.50	1.50	1.50	1.50
Molasses, lb	....	0.50	1.00	....	....
Water‡, gal	6.96	6.46	7.14	6.67	....
Feed required per cwt. gain, lb.:					
Shelled corn	504.0	502.3	472.2	568.3	470.8
Protein supplement	110.5	101.6	97.2	56.1	81.2
Silage	386.0	355.4	340.0	392.0	360.3
Mixed hay	82.7	76.0	72.7	83.6	77.2
Molasses	....	25.4	48.6	....	....
Feed cost per cwt. gain	$ 6.23	$ 6.26	$ 6.17	$ 5.95	$ 5.71
Pork gains per steer, lb	52.00	56.00	55.00	58.00	52.00
Necessary selling price (feed-lot weight, with pork credited) per cwt	$ 6.77	$ 6.74	$ 6.70	$ 6.61	$ 6.45
Profit per steer	$15.08	$16.25	$20.08	$15.83	$16.30
Returns per bushel corn fed	$ 0.73	$ 0.73	$ 0.81	$ 0.71	$ 0.76
Market appraisal:					
Buffalo	$ 9.25	$ 9.25	$ 9.50	$ 9.25	$ 9.00
Cincinnati	$ 8.95	$ 9.00	$ 9.25	$ 8.75	$ 8.65
Cleveland	$ 9.00	$ 9.00	$ 9.25	$ 8.90	$ 8.50
Pittsburgh	$ 9.00	$ 9.00	$ 9.50	$ 9.00	$ 9.00

Feed prices used: Shelled corn, 40¢ per bu.; linseed meal, $30, cottonseed meal, $25, dry rendered tankage, $40, silage, $3.50, hay, $10, and salt, $20 per ton; molasses, $1 per cwt.

Gains on hogs credited at $3.25 per cwt. net.

*Steer removed from Lot 3 February 18, due to urinary calculi; one from Lot 4 June 21, due to founder.

†Protein supplement: Lot 5, equal parts linseed meal, cottonseed meal, and dry rendered tankage. For other lots, equal parts linseed meal and cottonseed meal.

‡Water meters installed April 27.

Lot 4 trailed Lot 1 in gains throughout the test. This difference was slightly more marked during the first half of the test than during the second half. Their gains were somewhat cheaper, due to corn being cheaper than protein supplement. Some of the market appraisers valued them lower than Lot 1.

The relative value of corn and protein supplement is an important factor in determining the preferable amount of protein supplement to be fed. Judging from our experience, an increased amount of protein supplement during the first half of the test may have been desirable.

Lot 5 was fed the same amount of protein as Lot 1, although it required a smaller amount of the supplement. The amount of shelled corn fed was the same for both lots. Lot 5 never had any refuse feed; in fact, they wanted more all the time. Lot 1 had a little refuse shelled corn on a few occasions. We feel that the protein supplement fed to Lot 5 is superior to that fed Lot 1, although more work is needed to establish this point definitely. The lack of finish, which was doubtless due to a lack of full feeding, was surely responsible for their lower market appraisals. This lot outgained Lot 1, 40 pounds per steer, at considerable saving in feed.

The average market appraisal was discounted 60 cents per cwt. in figuring the financial returns.

The water meters were installed after the danger of freezing had passed and continued until the close of the test.

FARM MORTGAGE DEBT IN OHIO

J. I. FALCONER

Small returns from the sales of farm products and declining land values have made serious the farm mortgage situation in the corn belt. There was reported to be $259,000,000 of farm mortgage indebtedness in Ohio in 1930. The census of 1930 gives rather complete information as to the mortgage debt on farms operated by full owners in the State. Of the 136,332 farms operated by full owners, 45,628 reported a mortgage. The mortgage debt on these farms at that time equalled 43 per cent of their value. If one considers the decline in land values since 1930, it is probable that the ratio of mortgage to value on mortgaged farms in the State is now between 55 and 60 per cent. In seven typical western Ohio counties

the debt is now estimated to be two-thirds of the value of all mortgaged farms. The accompanying map, derived from the 1930 Census, gives the average mortgage debt per acre, in dollars, on the farms operated by full owners who reported a mortgage in 1930.

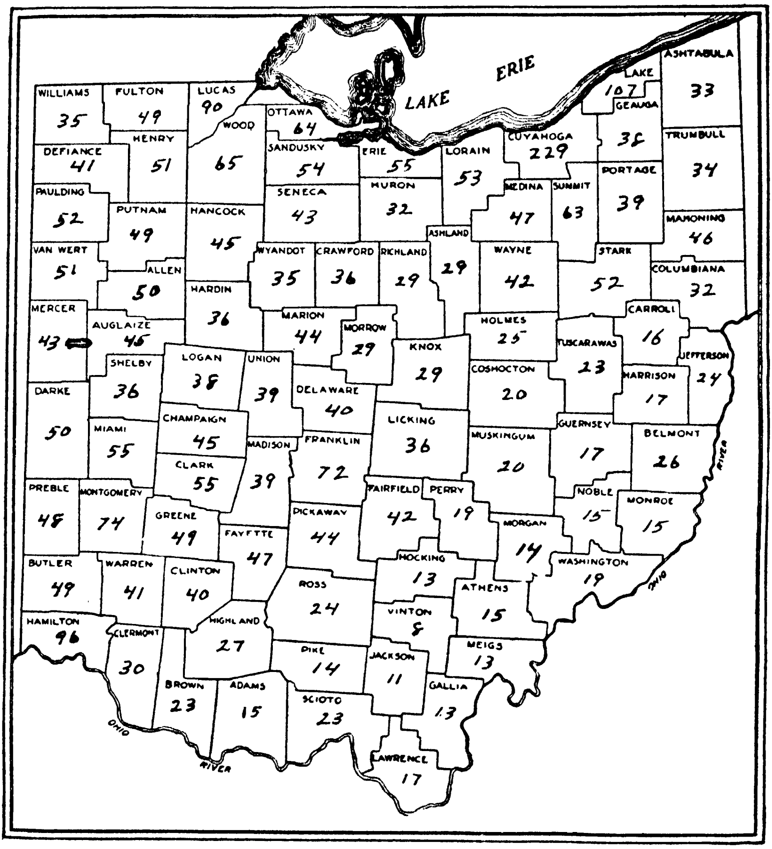


Fig. 1.—Mortgage debt per acre on mortgaged farms operated by the owner

ADJUSTING CASH RENT TO CHANGES IN THE PRICES OF FARM PRODUCTS

J. I. FALCONER

One of the problems of cash renting during the past 20 years has been that of adjusting the rent to changing prices. Leases are frequently drawn up in September to run for one year from the following March 1. A cash lease drawn up in September of 1930 to run for one year ending March 1932 would have found the prices of farm products at the end of the lease only one-half what they were when the lease was made. Obviously, this situation is unsatisfactory to both the owner and the tenant.

To meet this situation the following type of cash lease was recently worked out for a southwestern Ohio farm. The lease was drawn up in September to become effective for one year beginning March 1, 1933. The owner and the tenant agreed that $4.00 per acre would be a satisfactory rental charge, on the basis of present prices. At the time the lease was made the index of Ohio farm products prices, as published in the Bimonthly Bulletin, was 64. It was agreed that for every one point rise in this index for the period of the lease the rent per acre should be increased 2.6 cents per acre or decreased by the same amount if the price index should decline. Figured on this basis, the rent for the year 1930 should have been $5.66 per acre, and in 1919 the rent should have been about $8.00 per acre. This figure of 2.6 cents per acre was arrived at by a study of the relation of farm products price changes and cash rent changes since 1919.

One could check how closely this would compare with the past experience on his own farm by a little computation. From 1919 to July and August 1932 the index of prices of Ohio farm products declined 154 points. Divide the decrease in rent per acre since 1919 and 1920 by 154. If, for example, the rent per acre is now $4.00 less than it was during the war period, then divide $4.00 by the 154; this would give 2.6 cents per acre which would be the amount which the rent paid has changed for every one point change in the index number of prices of farm products.

On the farm in question it is the plan to agree on a new base rental each year, this rental then to be adjusted in accordance with the method given above.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

July and August saw some rise in the prices of Ohio farm products. This was especially true with hogs, beef cattle, butterfat, eggs, and wool. The Bureau of Labor index of wholesale prices also showed a rise, the first since July of 1929. Recovery from the financial panic is thought to be under way, but recovery from the business depression has made little progress as yet. Industrial production in July was reported as 58 per cent of the 1923-1925 average.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913	102	....	100	100	104	100	105	100
1914	99	100	101	102	102	102	105	107
1915	102	101	106	100	103	107	106	110
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	141	232	156	139	169	96	154	147
1929	139	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	128	130
1931	107	207	129	80	120	82	89	93
1931								
January	114	212	137	94	133	......	104	115
February	112	215	136	90	......	......	96	85
March	111	219	134	91	......	82	98	104
April	109	215	133	91	119	......	102	97
May	107	211	130	86	......	......	96	90
June	105	207	129	80	......	......	92	93
July	105	207	128	79	115	......	84	86
August	105	207	127	75	......	......	86	90
September	104	205	124	72	......	......	82	87
October	103	199	122	68	116	......	77	86
November	102	196	120	71	......	......	79	93
December	100	194	119	66	......	......	72	88
1932								
January	98	191	118	63	100	......	69	81
February	97	189	116	60	......	......	64	68
March	96	189	114	61	......	70	64	67
April	95	183	113	59	94	......	64	65
May	94	177	112	56	......	......	61	63
June	93	174	110	52	......	......	59	61
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Ohio

Agricultural Experiment

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

Relative condition of carrot foliage at time of harvest from an unsprayed plot (left) and one sprayed with bordeaux mixture plus calcium caseinate (right). The plant shown on the left was affected with both Cercospora "leaf spot" and Macrosporium "leaf blight".

SPRAYING CARROTS FOR CONTROL OF LEAF DISEASES

J. D. WILSON[1]

Carrots grown in some of the muck areas of northern Ohio have been injured during nearly every one of the past five summers by the attacks of two leaf diseases. The plants have been practically defoliated with subsequent reductions in yield, and crown rot has been severe in some instances in severely blighted fields. Leaf spot, caused by *Cercospora apii carotae* Pass., has been more common than leaf blight, caused by *Macrosporium carotae* Ell. and Lang., but the latter has caused the greater loss. Leaves affected with the Cercospora organism show small, circular lesions on the leaves. These areas are yellowish brown in color and often have gray centers. The lesions on the stems are somewhat elongated and darker brown in color than those on the leaf. The lesions due to Macrosporium are less definitely outlined and darker in color (often black) than is the case with leaf spot. Blight often kills the entire leaf, beginning its attack at the margins. Many of the leaves finally dry up and turn brown or black, giving the field a seared appearance. The older leaves are first attacked and may die while the central ones still remain green and free from disease.

Successful control of these diseases by the use of bordeaux mixture has been previously reported from New York and Massachusetts. During the summer of 1932 several fields at Lodi, Ohio, were sprayed with a 4-6-50 bordeaux to which 1 pound of calcium caseinate was added for each 50 gallons of spray mixture. The spray was applied under high pressure with a power sprayer.

Rainfall was very low during most of the growing period of 1932 in Ohio, being especially scarce in May, August, and September and below normal for April, June, and July. Since these two diseases are dependent on rainy periods for infection of the carrot leaves, the injury was not as severe as in other seasons when rainfall was more plentiful. Little benefit from spraying could be observed in two fields which were planted early and harvested in mid-season, since the diseases were very scarce in the unsprayed checks.

However, in one field planted in late April and sprayed at 10-day intervals from June 15 (when the carrots were about 6 inches tall) to July 15, inclusive, the results were very striking

[1]The author wishes to acknowledge his indebtedness to Mr. Robert Hall, of Lodi, Ohio, who was responsible for the application of the spray material.

when the carrots were harvested late in September. Little disease was noticeable even on the unsprayed section of this field as late as mid-August, but shortly after this the area which had not been sprayed began to show the brownish-yellow tinge characteristic of fields affected with these two leaf diseases. By mid-September the difference in color and denseness of the foliage on the sprayed and unsprayed sections was very noticeable. The sprayed area was very green with tall, dense foliage; whereas, on the portion which had not been sprayed, only a few green leaves remained upright, all of the outer ones having turned brown and fallen to the ground, leaving the sunburned crowns exposed to view. The two carrots shown in the figure (Frontispiece) illustrate the relative condition of the foliage in the two portions of the field, the carrot on the left being representative of those which received no spray and the one on the right of those which were sprayed.

The yields of roots were 544 and 907 bushels per acre from the unsprayed and sprayed parts of the field, respectively. This represents an increase in yield of 66.7 per cent due to four applications of bordeaux mixture. In addition, the roots from the sprayed area were much more uniform in size and were not so sunburned at the crown as were those from the unsprayed area.

These results indicate that, although increases in yield are not always obtained, decided benefits may result from spraying carrots with bordeaux mixture, especially if weather conditions are favorable for infection by either leaf spot, leaf blight, or both, at the time the carrots are about one-third grown.

SOME DETRIMENTAL EFFECTS OF SPRAYING TOMATOES WITH BORDEAUX MIXTURE

J. D. WILSON AND H. A. RUNNELS

It has been reported at various times in the literature on the general subject of the physiological influences of bordeaux mixture on plants that the presence of this spray on the leaves is beneficial during periods of intense sunlight and drouth. The reduction of leaf temperature due to the shading effect of the spray is said to decrease the transpiration rate and, perhaps, also to check the breakdown of chlorophyll. These beneficial effects have been

chiefly noticed on the potato where increases in yield have been brought about by spraying during extremely dry summers even when diseases were scarce or lacking. It has been found in the experiments to be reported here that the transpiration rate of the potato plant was increased much less by the presence of bordeaux mixture on its leaves than was the case with many other plants investigated. This fact may help to explain why this beneficial effect has not been found to extend to other plants, particularly the tomato.

From the standpoint of profit and loss, the advisability of spraying tomatoes is questionable, unless certain diseases, such as leaf blight, are so severe as to cause partial defoliation and subsequent lowering in yield. The first clusters frequently ripen later on sprayed plants, due partially to the fact that more leaves remain on the plant to shade the fruit. This delay in ripening usually necessitates the acceptance of a lower price for this very important part of the crop. This difference in price may offset any additional income received from an increased yield obtained by spraying, granted that such an increase occurs.

Preliminary experiments conducted in the greenhouse indicated that plants sprayed with bordeaux mixture lose considerably more water in the production of a gram of green tissue than do similar plants not sprayed. Plants sprayed with oil behave in a manner directly opposite to those sprayed with bordeaux mixture. In one experiment a series of 18 Coleus plants were grown, nine of them in soil held at 15 per cent moisture on the basis of dry weight and the other half in soil at 30 per cent moisture. Of the nine plants grown at each moisture content, three were sprayed with a 3-4½-50 bordeaux mixture, three others were sprayed with Volck (heavy) used at a 1-83 dilution, and the remaining three were left untreated. The first application of the spray materials was made as soon as the plants were well established in the containers. Three additional applications were made at weekly intervals. The plants were weighed each morning and the losses made up by the addition of water to the containers. At the end of the 28-day period the plants were cut off at the soil surface and immediately weighed.

Another experiment in which tomatoes were substituted for Coleus was carried out in a similar manner, except that the oil spray was not used. Sixteen plants were grown, eight of them at each soil-moisture content. Four in each lot of eight were sprayed with a 4-6-50 bordeaux mixture and the other four were left untreated.

Average relative growth in height and the amount of water transpired in the production of a gram of final green weight are shown in Table 1.

TABLE 1.—Influence of Spray Materials on Growth in Height and Amount of Water Used in the Production of Each Gram of Green Tissue for Coleus and Tomato Plants Grown at Two Soil-moisture Contents

Treatment	Height		Water transpired per gram of final green weight	
	Coleus	Tomato	Coleus	Tomato
	In.	*In.*	*Gm.*	*Gm.*
Soil at 15% moisture				
Check	9.0	13.1	20.1	28.7
Bordeaux mixture	6.2	10.8	33.7	33.5
Volck (heavy)	8.5	....	19.1	....
Soil at 30% moisture				
Check	15.5	18.9	33.7	36.6
Bordeaux mixture	12.0	17.5	36.2	40.5
Volck (heavy)	15.0	....	25.8	....

The amount of water transpired for the production of one gram of green tissue was much greater for the plants sprayed with bordeaux mixture than for the untreated plants. This was true both for Coleus and tomato. The excess of water used by the sprayed plants was relatively greater in the dry soil for both plants. As indicated in Table 1 and confirmed in numerous other experiments, plants sprayed with oil are not materially retarded in growth when compared with untreated plants. Furthermore, they are even more efficient in the use of water than are unsprayed plants.

The data relative to the height of the plants at the end of the experiment indicate that spraying with bordeaux mixture results in a retardation of growth which is especially marked in the soil held at a moisture content of 15 per cent but is not very noticeable for those plants grown with a soil-moisture content of 30 per cent. This is illustrated in Figure 1. The two plants shown in the upper part of the figure were grown at the lower soil-moisture content, and the plant on the left which was sprayed with bordeaux mixture is decidedly shorter than the untreated check. The difference in size between the sprayed and unsprayed plants grown at 30 per cent soil moisture is not nearly so marked.

In most of the experiments conducted in the manner described above, the plants grown with the lower soil-moisture content were found to wilt on days of high evaporation. This wilting naturally retards growth and elongation. The presence of bordeaux mixture on plants grown under these conditions caused them to wilt even more quickly than the untreated ones, since the transpiration rate

of the former was increased. This effect is illustrated in Figure 2. These two plants were grown under similar conditions until the one at the right was sprayed with a 4-6-50 bordeaux mixture. When this plant was sprayed, the soil moisture was approximately 15 per cent in both containers. The condition illustrated in the figure was arrived at 18 hours later. These results have been duplicated many times for tomatoes and a number of other plants.

In a further study of the influence of bordeaux mixture and oil sprays on the transpiration rate of plants several experiments have been carried out. The data relative to one of these are shown in Table 2.

Fig. 1.—Relative growth of sprayed and unsprayed tomato plants grown at two soil-moisture contents

An inspection of the data in Table 2 brings out again the difference between the relative growth of sprayed (with bordeaux mixture) and unsprayed plants grown at the two soil-moisture contents. The transpiration rate of the plants growing in dry soil and sprayed

with bordeaux mixture was higher than that of the unsprayed plants for a few days after treatment. The losses were then equal for a short period, and after that those of the sprayed plants began to fall behind. This is due to the fact that the increase in size and leaf area was not as great for the treated plants since they were placed under the handicap of a greater loss of water than the untreated ones. When the more rapid growth of the untreated plants increased their leaf area sufficiently over that of the sprayed plants, they finally began to lose more water than the latter, in spite of their lower transpiration rate per unit of leaf area. The plants grown at 30 per cent soil moisture did not usually show wilting, and the sprayed plants were not checked in their growth to any appreciable extent when compared with those which were untreated; as a result, they consistently maintained a transpiration rate in excess of the untreated checks over long periods. Similar results have been obtained for such plants as Coleus and cucumber. It may also be noted from the data given in Table 2 that the transpiration rate of the plants sprayed with oil was appreciably lower than that of the untreated plants at both soil-moisture contents. Slight injury due to the penetration of marginal leaf tissue by the oil was noticed on those plants grown at the lower soil-moisture content. This did not occur on the plants grown at 30 per cent soil moisture.

TABLE 2.—Average Daily Losses in Grams from Plants Grown at Two Soil-moisture Contents; One-third was Left Untreated, Another Third Treated with a 4-6-50 Bordeaux Mixture, and the Remainder Sprayed With Oil (Volck, Heavy, 1-83)

Dates for which average daily losses were determined	Soil moisture, 15 per cent			Soil moisture, 30 per cent			Atmometers, white, corrected values
	Check	Bordeaux	Oil	Check	Bordeaux	Oil	
	Gm.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Cc.*
October 24-26	35.0	40.3	31.1	45.6	55.2	45.8	29.6
October 26-28	30.8	35.0	23.5	28.3	35.0	21.1	12.8
October 28-30	39.5	39.5	25.8	48.3	56.7	34.8	29.6
October 30-November 1	34.1	33.1	19.0	38.7	46.0	27.0	17.6
November 1-3	71.1	64.5	34.6	87.5	90.6	57.5	33.6
November 3-5	92.3	83.8	50.0	119.6	121.3	80.1	47.2

A study of the results of the experiments performed in the greenhouse and described above indicated the advisability of conducting somewhat similar experiments in the field. On May 9, 1932, a field plot was set to tomatoes, one-half to Globe and one-half to Bonny Best. Each variety plot consisted of 30 rows and each row contained eight plants. Five different sprays were used. These, together with an untreated group, allowed the use of five rows (40 plants) of each variety for each treatment.

The following bordeaux mixtures were used: a 3-4½-50 and a 5-7½-50, made up with hydrated lime, and a 5-5-50 formula in which stone lime was substituted. Potash fish oil soap was included in each of these formulae at the rate of one pint in 50 gallons of spray material. Two oil sprays were used, a 1-83 dilution of Volck (heavy) and another of Volck (light) at the same concentration. These sprays were applied at weekly intervals under the rather low pressures developed with a hand pump, the first one being on June 22, at which time the plants had become well established.

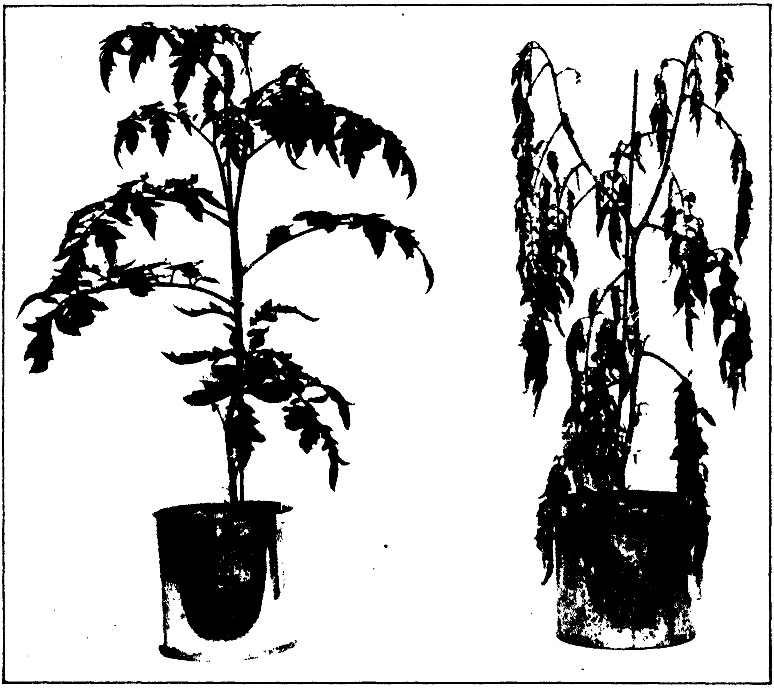

Fig. 2.—Relative condition of two tomato plants 18 hours after spraying with water (left) and 4-6-50 bordeaux mixture (right)

Extremely dry weather for about 3 weeks after the plants were set necessitated three applications of water to keep the plants alive. Because of these unusually dry conditions, early growth of the plants was greatly retarded, and the application of the first spray delayed beyond the time when it would have ordinarily been made. Although some rainfall had occurred up to June 22, this had not been sufficient to bring the soil moisture to the optimum for plant growth at the time the first spray was applied. As a result of this

condition the plants were still suffering from a lack of water on June 22, and 2 days after this the plants which had been sprayed with bordeaux mixture showed some signs of injury. The injury which consisted of a leaf burning was marginal on the leaflets near the top of the plant and almost entire on the newly formed terminal growth. This type of injury, which was almost certainly due to a desiccation of the leaf tissue, has since been repeatedly brought about by spraying plants on the verge of wilting with bordeaux mixture. The injury described above, when severe, resulted in a cessation of terminal growth of some of the plants. Many of the plants which did not show visible injury were retarded in growth to some extent for several weeks, as indicated by the relative heights of the plants receiving the different treatments, as shown for the date of July 16 in Table 3.

TABLE 3.—Influence of Bordeaux Mixture and Oil Sprays on Growth and Yield of Tomatoes

Treatment	Globe			Bonny Best		
	Growth		Total yield	Growth		Total yield
	July 16	Aug. 17		July 16	Aug. 17	
	In.	*In.*	*Lb.*	*In.*	*In.*	*Lb.*
Check	32.2	54.3	282	30.4	49.0	304
Bordeaux mixture (3-4½-50)	28.2	54.7	200	23.6	43.7	208
Bordeaux mixture (5-7½-50)	29.2	57.4	189	25.0	47.3	207
Bordeaux mixture (5-5-50)	28.2	52.8	179	25.6	43.0	218
Volck, light, 1-83	32.7	52.2	292	31.3	50.5	273
Volck, heavy, 1-83	32.0	52.9	298	30.8	48.3	284

Outside of the instances in which severe terminal injury occurred, this checking of growth was probably due to the increased use of water for transpiration and the consequent reduction of that available for use in growth. The plants receiving the oil sprays did not show this retardation of growth. The rainfall for the last half of July was plentiful, and, as a result, the plants which were receiving the bordeaux spray were able to resume rapid growth. The bordeaux-sprayed plants of the Globe variety grew so rapidly during this period that by August 17 they had overtaken and even passed those which were untreated or sprayed with oil. The recovery of the Bonny Best plants was not so marked.

The response of the plants sprayed with bordeaux mixture was not wholly one shown by checking of stem elongation, but there was also a reduction in the yield from these plants as compared with that from those left untreated or sprayed with oil. This result suggests the possibility that the increase in the use of water

brought about by spraying tomato plants with bordeaux mixture explains the frequently reported failure to obtain increases in yield from spraying when disease fails to appear. If soil moisture is plentiful throughout the season, it is not likely that a reduction in yield would ever be brought about by spraying with bordeaux mixture, but when it is deficient to the extent that the quantity of available water becomes the limiting factor in growth, any increase in the rate of water loss, such as that caused by the presence of the bordeaux residue on the leaves, will result in a decreased production of fruit. There is little indication that one bordeaux mixture formula is significantly more effective in influencing yield or growth than another. Although numerous pot experiments have shown that the application of oil sprays to tomato plants causes a significant decrease in transpiration as compared with that of untreated plants, the data given in Table 3 do not indicate that any increase in growth or yield is brought about by their application to plants growing in the field.

One of the most important relations existing between the spraying of tomato plants and their physiological response, which came to light in this experiment, is the apparent influence which the spray residue had on the amount of blossom-end rot which occurred on the sprayed plants compared with that on the untreated ones. In this experiment bordeaux mixture greatly increased blossom-end rot; whereas oil decreased it. It is now generally accepted that blossom-end rot is brought about by a severe desiccation of some of the cells in the blossom end of the fruit. When the soil-moisture content is low and the environmental complex favors high transpiration, the roots of the plant may not be able to absorb water from the soil as fast as it is being lost from the leaves. With this state of affairs existing, the leaves are able to withdraw part of the water from the fruit. If this withdrawal proceeds far enough, some of the cells collapse and are not subsequently able to recover, even though a plentiful supply of soil moisture later becomes available. As a result, the hard dry rot appears which is characteristic of the disease. If bordeaux mixture increases the transpiration rate of a tomato plant, then it would also be expected that it would bring about an increase of a disease initiated by a deficiency of water within the plant system, especially during periods of deficient soil moisture and high evaporation, such as were existent during most of August and September, 1932. On the other hand, the application of an oil spray such as Volck, which has been shown to decrease the transpiration rate, should make the

occurrence of these critical periods of low plant moisture less frequent, and, consequently, the amount of blossom-end rot should be decreased. That it was increased on those plants sprayed with bordeaux mixture and decreased on those sprayed with oil in this experiment is shown in Table 4.

TABLE 4.—Influence of Bordeaux Mixture and Oil Sprays on the Development of Blossom-end Rot on Tomato Fruits

Treatment	Percentage blossom-end rot on Aug. 11 in clusters 4, 5, and 6 on Globe plants set May 9	Total number of fruits showing blossom-end rot in whole crop when harvest was completed on Oct. 1		
		Globe planted May 9	Globe planted May 23	Bonny Best planted May 9
Check	17.5	231	57	45
Bordeaux mixture (3-4½-50)	49.3	461	63	87
Bordeaux mixture (5-7½-50)	51.1	476	79	73
Bordeaux mixture (5-5-50)	46.6	403	....	55
Volck (light, 1-83)	8.3	156	....	44
Volck (heavy, 1-83)	7.8	102	28	33

Some of the fruits on these plants began to ripen on August 1, but blossom-end rot was not noticed to be common until about 10 days later. The rainfall during the last half of July was plentiful, but, beginning with July 30, it was very scarce during the months of August and September. Evaporation, on the other hand, was considerably above the average for the 5 years of 1928-1932, inclusive. These associated factors of low rainfall and high evaporation placed the tomato plants under conditions very favorable for the development of blossom-end rot. On August 11 the amount of blossom-end rot present in the 4th, 5th, and 6th fruit clusters on the Globe plants which had been sprayed with bordeaux mixture was nearly three times as large as the number in the same clusters on the untreated plants; whereas the latter number was nearly twice that recorded for oil-sprayed plants. At the end of the season about twice as many blossom-end-rotted fruits had been harvested from the plants sprayed with bordeaux mixture as from the untreated check; whereas only about half as many were taken from the plants sprayed with oil. These differences were not nearly as great for the Bonny Best variety, probably due to the fact that it is not nearly as subject to the disease as is the Globe.

One factor which may be important in the occurrence of the larger amount of blossom-end rot on the plants sprayed with bordeaux mixture is that of the existence of a smaller number and volume of green fruits on these plants than on the untreated ones. Thus, a smaller supply of water in terms of a transpirational reserve

was available in the fruits of these plants, and, under conditions conducive to a high transpiration rate, these fruits, being small in number and volume, would be more severely desiccated than would the larger number and volume on an untreated plant. The real significance of this relation between fruit volume and the amount of blossom-end rot occurring has not been investigated to date but is mentioned here because of the possibility that it was of importance in the initiation of the disease in this instance.

Fig. 3.—Growth abnormalities in tomato following injury to the terminals by the application of bordeaux mixture when the plants were on the verge of wilting. Untreated plant (left), permanent terminal injury (center), strong leader developing from an injured plant (right).

Some of the plants on which the terminal bud was injured (as described above) by the first application of bordeaux mixture made on June 22 develcped very abnormally. Two characteristic types of growth are shown in Figure 3. The plant on the left represents the normal condition of the plants in the field about August 1. The central plant in the figure illustrates the form taken by these plants in which another terminal growing point was never developed. The plant on the right represents a condition similar to the one just described, except that a rapidly growing central shoot soon developed. By the middle of August the plants of the latter group could hardly be distinguished from the normal ones except that the

second, and sometimes the third, clusters were small in number. The possibility that these and similar injuries may occur wherever plants suffering from a lack of soil moisture are sprayed with bordeaux mixture makes it advisable to avoid the application of this spray material to plants in this condition, especially to the younger portions of them.

SUMMARY

Coleus and tomato plants grown in water-tight containers in the greenhouse showed an increase in the transpiration rate when sprayed with bordeaux mixture and a decrease when sprayed with oil. When these plants were grown with a soil-moisture content held at 15 per cent on a basis of dry weight, growth was retarded to a marked extent by spraying with bordeaux mixture. If the soil moisture was 30 per cent, a retardation occurred but was less than at 15 per cent. When Coleus and tomato plants were grown under such conditions, spraying with oil (Volck, heavy, 1-83) decreased the transpiration rate slightly but growth in height was not noticeably affected. Slight marginal injury occurred on both Coleus and tomato plants grown at a soil-moisture content of 15 per cent when sprayed with oil. This was also true on similar plants sprayed with bordeaux mixture.

Bordeaux mixture of three different formulae and a heavy and a light oil were used to spray tomato plants of the Bonny Best and Globe varieties grown in the field during the summer of 1932. The plants sprayed with bordeaux mixture were retarded in growth and in some instances were injured so that they later developed abnormally. This injury resulting from the application of bordeaux mixture was probably accentuated, or perhaps even initiated, because the soil moisture in the field was so low at the time the first spray application was made that the plants were suffering from a lack of water. With the advent of a more plentiful supply of rain in July, the plants of the Globe variety which had been sprayed with bordeaux mixture began to grow rapidly and had caught up with the controls by the middle of August. Blossom-end rot was three times as plentiful on Globe plants sprayed with bordeaux mixture as on the controls; whereas it was only one-half as plentiful on the oil-sprayed plants as on the controls. This disease was accentuated by the extremely low rainfall and high evaporation rates of August and September. Yields were decreased on both varieties by the application of bordeaux mixture. The oil sprays did not materially affect either growth or yield. In view of the

results obtained in these experiments it would not seem to be advisable to spray tomatoes with bordeaux mixture during drouth periods. Also, it is possible that the application of an oil spray in dry seasons would materially decrease the amount of blossom-end rot on tomatoes.

INCREASING THE VITAMIN-D CONTENT OF MILK

II. THE EFFECT OF FEEDING COWS A COD-LIVER OIL CONCENTRATE (VITEX)[1]

W. E. KRAUSS, R. M. BETHKE, AND WILLARD WILDER

This Experiment Station has been interested in finding a practical and cheap method of increasing the vitamin-D content of milk. With this in mind, irradiated ergosterol, a potent source of vitamin D, was fed to cows. This proved to be an effective but expensive procedure (see Bimonthly Bulletin for May-June, 1932). The next vitamin-D-containing supplement used was a cod-liver oil concentrate known commercially as Vitex.

Six Holstein cows were fed a basal ration composed of second cutting, green, leafy alfalfa and grain of the following composition:

360	lb. dried beet pulp
200	lb. yellow corn
150	lb. oats
50	lb. wheat bran
50	lb. linseed oilmeal
4.5	lb. salt

After the experiment had been in progress for some time, the beet pulp was soaked and fed separately. Eighteen pounds of grain (including the beet pulp) and 12 pounds of hay were the allowances chosen to meet the daily requirements of the cows. This system of feeding, rather than one based upon production, was followed in order to keep the food intakes of the cows equal and thus avoid any error through a larger or smaller intake of vitamin D in the basal ration. Towards the end of the experiment, as the cows decreased in milk flow, the hay allowance was reduced to 10 pounds per cow daily. On several occasions, owing to illness, the grain allowance of individual cows had to be reduced. These periods of lowered grain intake were usually of short duration and did not influence the results in any way, especially when it is considered that grains contain practically no vitamin D.

[1]This work was done under a fellowship granted by the National Oil Products Co., Harrison, N. J., manufacturers of Vitex.

At the end of 17½ days of feeding on the basal ration, the milk and fat production of each cow was calculated, the amount of milk having been recorded at each milking and a butterfat test having been made once each week. The cows were then divided into two groups of three cows each in such a way that the total milk and fat production of each group was approximately equal. During the next 4 days the milk from each group was collected separately. This was separated each day, and aliquot composite samples of cream for the 4 days were obtained. The cream was then churned, and the resulting butter was rendered into pure fat. During the last 4 days of each period of the experiment (Table 1), fat samples were obtained in a similar manner.

TABLE 1.—Experimental Feeding Plan

Period	Date 1932	Group I	Group II
I	January 4-January 25 (21½ days)	Basal	Basal
II	January 25-February 18 (24 days)	Basal plus 6,000 rat units of Vitex	Basal plus 15,000 rat units of Vitex
III	February 18-March 21 (32 days)	Basal	Basal
IV	March 21-April 14 (24 days)	Basal plus 40,000 rat units of Vitex	Basal plus 60,000 rat units of Vitex
V	April 14-May 13 (29 days)	Basal	Basal

The Vitex was measured out daily for each cow and mixed with the afternoon's allowance of grain. The amount of Vitex required to equal the desired number of rat units had been previously determined by rat assays.

The samples of pure fat obtained at the end of each period were assayed for vitamin D by the standard line-test procedure. The results of these assays are given in Table 2. These show that, when the cows received Vitex, the vitamin-D content of the butterfat increased over that obtaining when the basal ration only was fed and that, as the amount of Vitex fed increased, the vitamin D in the butterfat increased.

Since the amount of vitamin D per quart of milk is the thing of particular interest, this has been calculated for the samples of milk obtained at the close of each period (Table 3). When 60,000 rat units of vitamin D as Vitex were fed, the milk contained 30.35

Steenbock rat units of vitamin D per quart; when no vitamin D was fed, the milk contained less than 2.76 rat units per quart. Thus, at least an eleven-fold increase in vitamin-D content of the milk resulted.

TABLE 2.—The Critical Amount of Butterfat Required Daily to Produce Definite Evidence of Healing in Rats

Fat samples		Rat units of Vitamin D as Vitex fed cows daily	No. of rats	Critical daily level of butterfat	Rat units of Vitamin D per gram of butterfat
Period	Group				
				Mg.	
I	I	None	14	1,500	0.083–
	II	None	13	1,500	0.083–
II	I	6,000	14	800	0.156
	II	15,000	13	400	0.313
III	I	None	7	1,500	0.083–
	II	None	7	1,500	0.083–
IV	I	40,000	14	225	0.556
	II	60,000	14	150	0.833
V	I	None	5	750	0.167
	II	None	5	750	0.167

TABLE 3.—Fat Production and Steenbock Rat Units of Vitamin D Produced per Quart of Milk

Period	Group	Per cent fat	Fat per quart of milk	Rat units per gram of fat	Rat units per quart of milk
			Gm.		
I	I Control	3.35	33.43	0.083	2.77
	II Control	3.33	33.26	0.083	2.76
II	I 6,000 r. u. Vitex	3.41	34.03	0.156	5.31
	II 15,000 r. u. Vitex	3.52	35.13	0.313	11.00
III	I Control	3.60	35.93	0.083	2.98
	II Control	3.72	37.13	0.083	3.08
IV	I 40,000 r. u. Vitex	3.57	35.63	0.556	19.81
	II 60,000 r. u. Vitex	3.65	36.43	0.833	30.35
V	I Control	3.32	33.13	0.167	5.53
	II Control	3.61	36.03	0.167	6.02

In addition to the effect upon increasing the vitamin-D content of milk, it was of interest to determine whether or not the feeding of Vitex influenced in any way the milk production, fat percentage, total fat, and physical condition of the animals. The effect upon

fat production is of particular importance, since it is known that when cod-liver oil or other fish oils are fed to cows a decrease in the per cent of fat in the milk results.

TABLE 4.—Daily Milk and Fat Production, by Periods

Period	Ration	Cow	Milk	Fat	Per cent fat
			Lb.	*Lb.*	
I	Basal	2	32.4	1.13	3.49
		5	45.8	1.52	3.32
		380	37.1	1.21	3.24
		Total	115.3	3.86	
	Basal	1	48.5	1.77	2.91
		3	38.1	1.24	3.25
		382	33.3	1.27	3.83
		Total	119.9	4.28	
II	Basal plus 6,000 r. u. Vitex	2	30.8	1.12	3.62
		5	45.2	1.56	3.46
		380	38.3	1.22	3.19
		Total	114.4	3.90	
	Basal plus 15,000 r. u. Vitex	1	43.5	1.25	3.08
		3	34.1	1.11	3.45
		382	29.8	1.14	4.04
		Total	107.4	3.50	
III	Basal	2	35.8	1.01	3.92
		4	28.2	1.03	3.66
		380	37.3	1.20	3.21
		Total	101.3	3.24	
	Basal	1	39.8	1.38	3.47
		3	32.1	1.19	3.70
		382	31.6	1.27	4.00
		Total	103.5	3.84	
IV	Basal plus 40,000 r. u. Vitex	2	30.0	1.10	3.67
		4	28.1	1.10	3.93
		380	35.8	1.12	3.12
		Total	93.9	3.32	
	Basal plus 60,000 r. u. Vitex	1	37.4	1.25	3.35
		3	34.2	1.22	3.56
		382	33.0	1.33	4.05
		Total	104.6	3.80	
V	Basal	2	30.4	1.11	3.64
		4	22.7	0.76	3.32
		380	34.0	1.02	3.00
		Total	87.1	2.89	
	Basal	1	33.0	1.12	3.41
		3	33.8	1.20	3.55
		382	32.4	1.25	3.86
		Total	99.2	3.57	

The cows were carefully observed daily and nothing unusual was detected in their behavior or physical condition when Vitex was fed. From the daily milk records and weekly butterfat tests, the data in Table 4 have been calculated. It is apparent that total milk and fat production decreased as the experiment progressed, this being particularly noticeable during Periods IV and V. There were no indications that this was related in any way to the feeding of Vitex and can probably be attributed to the normal decrease in production which accompanies advancing lactation. The considerable drop in production which occurred in Group I during Period III was due to the substitution of a lower-producing cow (No. 2) for one which had suddenly died (No. 5), and the relatively large drop which occurred in the same group during Period IV was partly due to illness of Cow No. 2. The death of Cow No. 5 and the illness of Cow No. 2 were not due to the feeding of Vitex. In the light of these considerations, the data in Table 4 show that the feeding of Vitex at any of the levels did not influence milk or fat production.

Although an eleven-fold increase in the vitamin-D potency of milk resulted from feeding cows 60,000 rat units of vitamin D in the form of Vitex, this increased potency (30.35 rat units per quart) was far below the 160 rat units per quart recommended for milk that is to be used as an antirachitic agent for infants. It must be pointed out in this connection that the milk produced on the basal ration was extremely low in vitamin D. Aside from this, the cost of the Vitex eliminates this product as one that can be fed to cows for the purpose of increasing the vitamin-D content of milk to the desired extent.

PRICES OF CATTLE AND HOGS COMPARED WITH WHOLESALE AND RETAIL PRICES OF BEEF AND PORK

GEO. F. HENNING AND J. J. ANDERSON

The relationship between the prices received by farmers for their products and the prices consumers pay for them or other products processed from those sold by the farmer are of increased interest in periods of declining prices. It is interesting now to compare the relationship between prices received by farmers for hogs and cattle and the prices consumers pay for beef and pork.

Three series of prices have been used. The U. S. Department of Agriculture reports monthly the prices received by farmers in Ohio for their hogs and cattle. This is taken as of the 15th of each month and is reported in *Crops and Markets*. These prices were thought to be representative of the prices received by farmers in Ohio for their hogs and cattle.

Wholesale prices for Ohio were not obtainable, but wholesale prices for beef and pork at Chicago and New York are given in *Crops and Markets*. Since Ohio is about midway between these two cities, it was assumed that the average price between Chicago and New York would be representative of the wholesale price for beef and pork in Ohio. To be representative of all cattle sold from Ohio farms, the wholesale price used was that for medium grade beef, 500 pounds and up. For pork, wholesale prices of 10 to 12-pound pork loins, 8 to 10-pound No. 1 bacon, 12 to 14-pound No. 2 hams, and lard were used. No by-products obtained from beef or pork are considered in these comparisons.

Reliable retail prices for all meats in Ohio are not obtainable for a series of years. The best prices we could find were those secured by the Bureau of Labor for the three cities Cincinnati, Cleveland, and Columbus. The Bureau of Labor secures retail prices for sirloin steak, round steak, rib roast, chuck roast, plate beef, pork chops, sliced bacon, sliced ham, and lard. These five cuts for beef and four cuts or products of pork formed the basis of retail prices used in these comparisons.

Comparing prices of hogs with pork and cattle with beef is not the same as comparing the price of eggs at the farm and the price to the consumer. This is at once realized by an illustration. Take

a 200-pound hog, for example, which a farmer sells alive. The packer slaughters this 200-pound hog but does not get 200 pounds of pork. Instead, the packer will get a pork carcass, weighing ordinarily about 150 pounds including the head and feet. The hog carcass must be cut and trimmed into hams and sides, etc., which the packer processes into cured ham and bacon. The lean trimmings are ground into sausage and the fat is made into lard. In all of this there is some shrinkage. Consequently, the packer sells to the retailer a smaller quantity than he receives from the farmer, and, in turn, the retailer has a small shrinkage in some products which are sold to the consumer. The same is true for beef. Of course, the packer gets the by-products, such as the hide from cattle, hoofs, casings, hair, etc. They enter into this shrinkage and have some value.

On the average, Ohio farmers sell their hogs at a weight of a little over 200 pounds and their cattle somewhat under 900 pounds. In this analysis then the comparisons are made on the basis of a 200-pound hog sold by the farmer and the meat products sold from a 200-pound hog.

A 900-pound steer was used for beef. On the basis of average dressing percentages and cut-out tests made by the Meats Division of the Animal Husbandry Department, Ohio State University, we have weighted the prices on the basis of the amount of meat sold from a 200-pound average hog and a 900-pound average steer. Ordinarily, the retail prices we have used represent about 65 to 70 per cent of the total retail value of beef and 55 to 60 per cent of the retail value of pork. With this explanation an examination of Tables 1 and 2 gives the relationship in dollars between the amounts received by farmers, wholesalers or slaughterers, and retailers for pork and beef for the past 5 years and as far as data were available in 1932. Likewise, an index of these values has been constructed to facilitate comparison, with 1927 considered as the base or 100.

Table 1 shows that in 1927 farmers received approximately $74 for a 900-pound average steer, $92 in 1929, $55 in 1931, and $42 for the first 8 months of 1932. When this is constructed into an index with 1927 as 100, 1929 is 124.3, 1931 is 75.1, and the first 8 months of 1932 average 57.7. In other words, instead of saying that the price received for a 900-pound steer dropped from $74 in 1927 to $42 for the first 8 months of 1932, one can say by index numbers that the price dropped from 100 in 1927 to 57.7 for the first 8 months in 1932, which is a drop of 42.3 points.

TABLE 1.—The Estimated Amount in Dollars Received by Farmers for a 900-pound Average Steer, the Amount Received by Wholesalers for the Beef from a 900-pound Steer, and the Amount Received by Retailers for Five Cuts of Meat from a 900-pound Steer. Also Index of These Amounts. (1927=100)*

	Amount in dollars received by			Index of amount received by		
	Farmers for a 900-pound steer	Wholesalers for beef from a 900-pound steer	Retailers for five cuts from a 900-pound steer	Farmers	Whole-salers	Retailers
1927	74.02	74.60	78.04	100.0	100.0	100.0
1928	92.92	90.96	90.27	125.5	121.9	115.7
1929	92.02	88.24	96.13	124.3	118.3	123.2
1930	72.45	70.61	87.24	97.9	94.7	111.8
1931	55.57	53.37	72.41	75.1	71.5	92.8
1932						
January	45.90	51.39	63.87	62.0	68.9	81.8
February	41.40	47.36	59.60	55.9	63.5	76.4
March	42.30	50.68	60.26	57.1	67.9	77.2
April	41.40	50.44	57.79	55.9	67.6	74.1
May	38.70	47.83	57.41	52.3	64.1	73.6
June	39.60	50.68	58.32	53.5	67.9	74.7
July	46.80	56.70	61.97	63.2	76.0	79.4
August	45.00	53.38	63.11	60.8	71.6	80.9
September	43.20	55.28	61.45	58.4	74.1	78.7
Av. from January to September	42.70	51.53	60.42	57.7	69.1	77.4

*Four months February, May, August, and November were used.

A close examination of Table 1 reveals several changing relationships during the past 5 years. This shows that during 1927 packers sold the carcass beef for approximately the same price as they paid the farmer for the live steer. In turn, the retailers sold five cuts (on which we have retail prices) of this representative steer for about $4 more than the farmer received for the live steer. It was mentioned that these five cuts ordinarily bring from 65 to 70 per cent of the total retail value of a beef carcass. We have no way of knowing whether in 1927 the remaining cuts would have brought 30 or 35 per cent more. In 1929 a 900-pound live steer brought about $93. The packer sold him to the retailer for around $91 and the retailer from five cuts realized $90. On the basis of index numbers (the three right-hand columns of Table 1), this shows that the farmer realized more relatively than did the wholesaler or retailer. This is usually the case with rising prices. In 1930 prices dropped some from the 1928 and 1929 levels. Wholesale values dropped along with live prices, but not so with retail. In 1931 farmers received around $55 for a 900-pound steer, and, in turn, the packer sold the beef from this steer to the retailers for around $53; the retailer, in turn, sold five cuts from such a steer for around $72. The index for 1931 of live prices for the steer stood at

75.1, the carcass beef at 71.5, and the retail beef at 92.8. This would indicate that the retailers were slow to narrow their margins and lower their prices as the margin for the farmer and the packer dropped.

During 1932 the price of live steers has continued to drop, reaching the $40 level for a representative 900-pound average Ohio steer. At this point a changing relationship has taken place between the farmer price and the wholesale price. The wholesale price of beef maintained its price during the early part of 1932 even though live cattle prices declined from their 1931 level. This is clearly seen upon examining Table 1. For the first 8 months of 1932 the live price of a 900-pound steer dropped nearly $13 from the 1931 level; whereas wholesale beef only dropped about $2 for the same period. It should be said that by-product values from beef which are not considered in this analysis dropped considerably during this same period. Hence, the slaughterer of beef has, no doubt, had to change his price relationship in order not to have too heavy losses. At the same time the retail price of five cuts from a 900-pound steer dropped from $72 in 1931 to $60 for the first 8 months of 1932, or a $12 drop. This is about the same drop as that taken by the farmer. But this must be kept in mind, the price to the retailer only dropped about $2, but he passed on a $12 drop to the consumer which would indicate that the retailer has narrowed his margins considerably on beef during the past year.

Passing to a comparison of hog and pork prices, a more uniform relationship is found, Table 2. For the years 1927, 1928, 1929, and 1930 the amount received for a 200-pound hog fluctuated in about the same proportion as did the amount received from four wholesale cuts and four retail cuts. Farmers for the year 1930 received around $18.80 for a 200-pound hog, the retailer sold four retail cuts for about $23. Approximately the same proportion of farm price, wholesale price, and retail price existed during the four years 1927, 1928, 1929, and 1930.

In 1930 the farm price began to drop, so that by 1931 the farmer received only $13 from a 200-pound hog. Four wholesale cuts from a 200-pound hog realized $15 and four retail cuts $19. The farmer took a drop of $5.70, the wholesaler $4.28 on four cuts, and the retailer about $4. This shows that the retailer and wholesaler were passing on from four cuts a large proportion of the drop taken by the farmers. It is well to remember that the four wholesale cuts represent about 70 to 75 per cent of the wholesale value of a pork carcass and the four retail cuts represent from 55 to 60 per

cent of the total retail value. If the remaining cuts upon which we do not have prices fluctuated in about the same proportion as the cuts compared above, then the retailer and wholesaler of pork passed on to the consumer just about the drop that the farmer took up to 1932.

TABLE 2.—The Estimated Amount in Dollars Received by Farmers for a 200-pound Average Hog, the Amount Received by Wholesalers and Retailers for Four Cuts of Pork from a 200-pound Average Hog. Also Index of These Amounts. (1927=100)*

	Amount in dollars received by			Index of amount received by		
	Farmers for a 200-pound hog	Wholesalers for four cuts from a 200-pound hog	Retailers for four cuts from a 200-pound hog	Farmers	Wholesalers	Retailers
1927	20.45	21.07	24.94	100.0	100.0	100.0
1928	18.75	20.08	23.65	91.7	95.3	94.8
1929	20.25	20.16	23.86	99.0	95.7	95.6
1930	18.80	19.54	23.15	92.0	92.7	92.8
1931	13.10	15.26	19.22	64.1	72.4	77.0
1932						
January	8.00	10.43	14.31	39.1	49.5	57.4
February	7.60	10.50	13.58	37.2	49.8	54.4
March	8.60	10.97	14.24	42.1	52.1	57.1
April	7.80	10.53	13.72	38.1	50.0	55.0
May	6.40	9.05	13.08	31.3	42.9	52.4
June	6.40	9.15	12.30	31.3	43.4	49.3
July	9.40	11.43	14.40	46.0	54.2	57.7
August	9.20	10.60	13.85	45.0	50.3	55.5
September	8.40	10.49	13.75	41.1	49.8	55.1
Av. from January to September	7.977	10.35	13.692	39.0	49.1	54.9

*Four months February, May, August, and November were used.

The farm price of pork continued to drop during 1932. For the first 8 months the Ohio farmer received about $8 for a 200-pound hog, the wholesaler sold four wholesale cuts for about $10.35, and the retailer sold these same cuts for about $13.70 to the consumer. This shows that the packer and retailer have been passing on to the consumer in these four cuts about the same drop as the farmer has taken on the live 200-pound hog. If the same relationship holds for the remaining cuts upon which we do not have prices, then the packer and retailer are passing on more than the drop assumed by the farmer, which would mean that they have narrowed their margins over what they were for the 4 years 1927, 1928, 1929, and 1930.

Retail and wholesale prices of pork have followed rather closely with the live price of hogs; although they have lagged and probably have not dropped as much as some would like, yet they have followed rather closely.

With beef, this relationship does not exist to the same extent that it does with pork. No doubt for various reasons the wholesale prices during the first part of 1932 did not follow the same relative drop as did live prices of cattle. Part of this, perhaps, can be explained by the loss in by-product values. On the other hand, this comparison would indicate that the retailer in 1932 was making less on beef than during any of the previous 5 years, for he held retail prices closer to wholesale prices and thus reduced his margin. When only index numbers are used for comparison (as shown in the three right-hand columns of Tables 1 and 2), a mistaken conception might be assumed.

For index numbers, assume that the same relationship should hold in 1932 as in the base year, 1927. Such reasoning does not consider that we are living in a dynamic and changing society. As an example, rents, freight rates, leases, mortgages, interest, etc., do not respond to change as do raw material prices, such as hogs and cattle. Hence, it may be difficult for retailers to lower their margins in the same proportion, when the lease or rent on the building has several years to run. Other factors of expense and costs of distribution are likewise stubborn in their adjustments in price drops such as we have had in the past 3 years. The difficulty of not properly interpreting index numbers can be shown by an example. A 200-pound live hog in 1927 sold for about $20. The wholesale value of the same hog was about $30 and the retail value about $40. By 1932 this same hog would sell for $10 or less, or a 50 per cent drop from 1927, which means on an index number basis a drop from 100 to 50, or a 50-point drop. In actual money the live hog would bring $10 less in 1932 than in 1927. Then if the packer dropped the wholesale price 50 per cent from 1927, which was $30 in our illustration, he would have to drop the price to $15. In other words, the farmer would take a $10 drop and the packer would have to narrow his margins, profits, wages, interest, etc., enough more to make up the extra $5. Now if the retailer sold the meat from a 200-pound hog for $40 in 1927, as was used in the illustration, and would also drop 50 per cent, the meat from that same hog would have to be sold for $20. This would mean that $10 of the drop would be taken by the farmer, $5 by the packer, and the retailer would have to cut the remaining $5 from his wages, overhead, profits, rents, interest, payments on principal, etc. Such adjustments are easier said than done in actual dynamic conditions. Yet, when you are comparing the index of the farm price of hogs with wholesale and retail price of pork and say that live hogs dropped

from 100 in 1927 to 50 in 1932 and that wholesale and retail prices did not follow, the inference may be that some one is making more than his share when such may not be the case. As a matter of fact, the packer is passing along the full drop the farmer has taken when he sells the wholesale hog for $20, or a drop from 100 to 66⅔, and, likewise, the retailer sells the meat from a 200-pound hog for $30, or a drop from 100 to 75. It is very desirable for both the packer and retailer to narrow their margins, reduce their rents, leases, interest, wages, etc., so that the consumer may benefit from such price drops of food produced by the farmer. Consumption will increase, prices will be brought into proper relationships, and foundations will be made for a normal supply of beef and pork. Then the farmer will again assume his proportionate share in purchasing the products of our industrial society.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

The tendency for prices to rise, which seemed to be evident in July and August, did not continue during September and October. It now appears that the prices received by the Ohio farmer for his products in 1932 will be less than one-half those of 1930. Industrial production in September was reported by the Federal Reserve Board to be 67 per cent of the 1923 to 1925 average; whereas factory payrolls were reported at 42.1 per cent of the average for that period.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	99	100	101	102	102	102	105	107
1915........	102	101	106	100	103	107	106	110
1916........	125	114	123	117	113	113	121	121
1917........	172	129	150	176	140	119	182	198
1918........	192	160	178	200	175	131	203	243
1919........	202	185	205	209	204	135	218	266
1920........	225	222	206	205	236	159	212	242
1921........	142	203	156	116	164	134	132	136
1922........	141	197	152	125	145	124	127	136
1923........	147	214	153	135	166	122	134	149
1924........	143	218	154	134	165	118	133	150
1925........	151	223	159	146	165	110	159	164
1926........	146	229	156	136	170	105	155	176
1927........	139	231	154	131	173	99	147	163
1928........	141	232	156	139	169	96	154	147
1929........	139	236	155	138	169	94	151	161
1930........	126	226	146	117	154	90	128	130
1931........	107	207	129	80	120	82	89	93
1931								
January...	114	212	137	94	133	....	104	115
February..	112	215	136	90	....	....	96	85
March.....	111	219	134	91	....	82	98	104
April......	109	215	133	91	119	....	102	97
May.......	107	211	130	86	....	....	96	90
June......	105	207	129	80	....	.....	92	93
July.......	105	207	128	79	115	....	84	86
August....	105	207	127	75	....	....	86	90
September.	104	205	124	72	....	....	82	87
October....	103	199	122	68	116	.....	77	86
November.	102	196	120	71	......	.....	79	93
December..	100	194	119	66	......	......	72	88
1932								
January...	98	191	118	63	100	....	69	81
February..	97	189	116	60	....	....	64	68
March.....	96	189	114	61	....	70	64	67
April......	95	183	113	59	94	....	64	65
May.......	94	177	112	56	....	....	61	63
June.......	93	174	110	52	....	....	59	61
July.......	94	171	109	57	90	....	63	67
August....	95	172	108	59	....	..	66	73
September.	95	177	107	59	....	. ..	65	67
October....	94	....	....	56	84	....	63	68

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 503. Ohio Agricultural Statistics for 1929-1930-1931, by
A. R. Tuttle, R. E. Straszheim—U. S. Department of Agriculture
P. P. Wallrabenstein—Ohio Experiment Station

This bulletin contains estimates of acreage, yield per acre, and total crop production, numbers of livestock on farms, and prices of crops, livestock, and livestock products for the State, as well as estimates for the counties, for the years 1929, 1930, and 1931. There are included also the United States Crop Summary for 1929, 1930, and 1931, tables showing the average farm wages for these years, and numerous summary tables giving data on crop statistics for 1919 through 1931.

Bulletin 504. Marketing Cannery Tomatoes on Grade in Ohio, by Chas. W. Hauck. Until recently Ohio canners of tomatoes and tomato products have purchased raw stock from growers at agreed flat rates per ton. Purchase of raw stock on U. S. grades and government inspection is displacing the flat rate system. This bulletin presents some of the problems involved in the new system and shows that marketing of cannery tomatoes on grade and inspection results in: Greater returns to growers, lower labor costs and higher net returns to canners, improved quality and larger volume of finished products per ton of raw stock, and more equitable relationships between growers and canners.

Bulletin 505. Factors Influencing the Dressing Percentage of Hogs, by G. F. Henning and W. B. Stout. Dressed weight has been accepted by a few livestock marketing agencies and by several slaughterers as a better basis of settlement in the marketing of hogs than liveweight, although price determination is made on the basis of liveweight. With this in mind, this study, based on data obtained from three sources (tattooed hogs from seven cooperative associations, records from 437 carloads of hogs shipped by the National Order Buying Company to one slaughterer, and data on Federal Inspected Slaughter for the eight years 1923-1930), was made to determine some of the factors which influence yield.

Bulletin 506. The Influence of Laundering and Exposure to Light upon Some Wash Silks Used for Outer Garments, by Marion E. Griffith. The silks were tested for the effect of light and laundering upon the strength and color fastness of pure dye, weighted, and wild silks. It was found that price was highly correlated with quality, that pure dye silks were stronger than weighted silks, that branded silks showed no superiority over unbranded, and that there was great similarity in the fading of the pure dye and the weighted silks.

Bulletin 507. The Trend of Wheat Production in Ohio, by C. A. Lamb. This is a historical study of the trend of wheat production in Ohio with a prophecy of what might be the trend in the future.

Bulletin 508. Apple Thinning, With Special Reference to Grimes Golden and Jonathan, by C. W. Ellenwood and F. S. Howlett. The results from thinning Grimes and Jonathan for a 3-year period and from early thinning of early varieties are presented. The results of the thinning are given in terms of total weight of the fruit harvested per tree, of effect on size and color of fruit, and of response of trees in dry seasons.

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Ohio Agricultural Experiment Station

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

Trees saved the soil

SOIL EROSION AND TREE PLANTING

EDMUND SECREST

One of the important problems confronting agriculture relates to soil losses through erosion. These losses have occurred in greater or less degree throughout the rolling and hilly lands of Ohio and are more pronounced on some soils than on others. Erosion takes place in two ways. The most insidious type is sheet erosion, where the fertile top soil washes off uniformly without gullies. On other soils, erosion takes the form of gullying, the gullies varying in depth according to the character of the top soils and subsoils. Severe gullying of land soon destroys its usefulness for annual crops or pasture.

On many thousands of acres in certain parts of Ohio erosion has removed the entire 7 or 8 inches of the brown, forest-formed soils exposing sterile, clay subsoils. In many places the subsoil clays have washed down to the shales. Such areas constitute a problem in reclamation.

Experiments in various regions of Ohio demonstrate that gullied lands can be reclaimed by plantations of forest trees (Frontis). Several species of pines have proved useful for this purpose, and the rate of growth indicates that they will produce commercial timber at the same time. In some instances the growth of the pines is even more rapid on these eroded areas than on more fertile soils elsewhere.

The checking of soil erosion is accomplished not so much by the roots of the trees as by the accumulation of needle litter which falls from the trees. This mats closely to the ground, increasing the water-absorptive capacity of the soil and, at the same time, shedding the surplus run-off of water without washing any of the soil with it.

Among the species of trees which are proving best for reclamation are the red, white, and Scotch pines in the northern latitude of the State and, in addition, shortleaf and pitch pines in the southeast quarter. If soils are badly gullied, it is best to use 4-year transplants which are 10 to 12 inches high. They should be spaced no further apart than 6 x 6 feet, or at the rate of 1200 trees per acre. One man can plant from 500 to 1000 trees per day, depending upon his energy and ability and upon the condition of the soil.

The black locust is well adapted for reclaiming eroded limestone soils. By the use of 1-year seedlings reforestation with this species can be accomplished at small cost.

Trees for forest planting may be purchased from the Ohio Department of Forestry, Wooster, Ohio.

SUDAN GRASS CULTURE

L. E. THATCHER

Soil and fertilizer requirements.—Soils which produce good crops of corn are well suited to Sudan grass. On the other hand, sandy soils that dry out quickly and cold, wet, heavy soils are not as well suited to the crop. Liming is seldom necessary for Sudan grass, since it grows fairly well on acid soils.

On manured land, a light application of 150 to 200 pounds per acre of 20% superphosphate will generally be all that is necessary to give a good hay crop. If no manure is available or if the land is rather poor, a complete fertilizer is necessary to give good yields. This fertilizer may be a 4-12-4, or one of similar analysis. On very dark colored soils, particularly on mucks, the percentage of potash should be increased to something like a 4-10-6.

For pasture, a luxuriant growth is desired. In addition to the treatment recommended for hay, it may be desirable to topdress the stand during the summer if it is not growing vigorously, using 100 to 125 pounds of nitrate of soda, 75 to 100 pounds of sulfate of ammonia, or an equivalent amount of other quickly available nitrogenous fertilizers. Topdressing is not necessary unless the growth is slow or the pasture heavily stocked.

Time of planting.—Sudan grass is a native of tropical Africa; therefore, it is necessary to wait for the soil to warm up in the spring before sowing the seed. If sown in cold soil, germination will be slow and irregular, many seeds will rot, and the plants that do start will grow very slowly until warm weather comes. In the meantime, weeds start and are likely to smother the Sudan grass. The period of May 15 to June 1 will be, on the average, as early as it is practicable to sow Sudan grass in Ohio. It may be sown as late as July or August, but the yields of hay will be less and the pasture period greatly shortened.

Seedbed preparation.—Early plowing and seedbed preparation as for corn, followed by 2 weeks of fallow cultivation to kill sprouting weed seeds, conserve soil moisture, and firm the seedbed, will generally give better stands of Sudan grass than if it is sown on a poorly prepared, loose, and dry seedbed.

Sudan grass will sometimes do fairly well following early oats, if the stubble is disked. Generally, however, the soil moisture is too low for a good stand and yield. The success of the crop will depend upon prompt germination and abundant summer rains.

Sowing the seed.—Good, plump seed may be sown with a grain drill, using the wheat feed and drilling solid as for small grain (row seeding and cultivation are seldom used now outside of the seed-production areas). When set to sow 2 pecks of wheat, the drill will usually sow about 15 to 20 pounds of Sudan grass per acre. If the drill cannot be set to sow this small amount, the seed may be mixed with an equal bulk of screened, cracked corn. If the drill method cannot be used, the seed may be broadcast and then covered with a weeder, harrow, drag, roller, or cultipacker. Any method may be used which will cover the seed shallow, ½ to 1 inch deep on heavy soils and 1 to 2 inches on light, loose soils. If the seedbed is dry, rolling or cultipacking will hasten germination.

The alfalfa grass-seed drill with double feed is ideal for sowing Sudan grass. Use the feed having the large opening.

Rate of sowing.—Fifteen to 20 pounds of seed per acre will usually give a satisfactory stand, although 25 pounds are generally advisable if any unfavorable conditions are present. The heavier rates of seeding give the finer quality hay. Thin stands may yield as many tons per acre, but the coarse stems are harder to cure.

Effect of hot, dry weather on Sudan grass.—During periods of hot, dry weather, Sudan grass continues to grow after most crops have stopped and only checks its growth when the soil moisture has become very low. It requires a greater amount of water to produce a pound of dry matter of Sudan grass than one of corn, but the extensive, fibrous root system of the Sudan grass enables it to draw upon the soil moisture to a greater extent than most crops. The advantage of having the seedbed well supplied with moisture at seeding time is thus explained. Sudan grass makes a quick recovery and grows vigorously just as soon as rain falls.

The ability of Sudan grass to grow during the hot, dry weather of July and August makes it an ideal pasture crop for that period when native blue-grass pasture is at its lowest carrying capacity.

Utilization.—Sudan grass is one of the best summer pasture crops. It is usually big enough to pasture when it is 5 to 6 weeks old, or sooner if it is 12 to 14 inches tall. Sudan grass for pasture should not be allowed to get coarse and woody as it has a tendency to do if the stand is thin or if it is not pastured heavily enough. It may be kept in a succulent condition by mowing off the tall shoots with a mower, with the cutter-bar set high to avoid cutting off the good pasture growth.

It may be cut for hay when the heads begin to appear or later until the seeds are in the soft dough stage. The best quality of hay is made from the early cutting. Occasionally, the early cutting will be followed by a second growth which may be pastured for a short time or until frost kills it. However, in Ohio, it is seldom possible to obtain two hay crops in one season. It takes somewhat longer to cure Sudan grass hay than timothy or clover hay. Its feeding value is about equal to first-class timothy hay or medium-grade mixed hay.

It may be cut green for a soiling crop. Under circumstances which prevent its being made into hay, Sudan grass may be made into silage. Its feeding value is about equal to corn silage.

Sudan grass seed is so cheap that Ohio farmers cannot afford to grow it as a seed crop. The commercial seed production areas are located in Texas, Oklahoma, Kansas, western Missouri, eastern Colorado, and in parts of New Mexico.

Buy good seed.—Many failures to get good stands of Sudan grass can be traced to the use of poor seed, light in weight and low in percentage of germination. The best quality seed should weigh 35 to 40 pounds per measured bushel.

Sudan grass seed should be free from Johnson grass seed. Johnson grass is a perennial with an underground rootstalk something like that of quack grass and is very difficult to eradicate once it becomes established.

Formerly, it was thought that Johnson grass would not survive Ohio winters, but it has become a serious weed pest along the river bottoms in southern Ohio from Circleville south. According to members of the Department of Farm Crops, of the Ohio State University, who are studying methods of eradication[1], it is probably the most serious single weed pest in Ross County. It has been reported in Erie and Cuyahoga Counties in northern Ohio and in

[1]Dr. C. J. Willard and Dr. R. D. Lewis are preparing a circular on the control of Johnson grass.

Franklin County, central Ohio, but only occasionally. Nevertheless, it has possibilities for doing great harm and every precaution should be taken to prevent its spread.

Contaminated Sudan grass seed cannot be charged with having caused all of the areas of Johnson grass infestation in Ohio, but it is undoubtedly responsible for some of them. This fact should not deter anyone from growing this most valuable crop but should emphasize the necessity of being careful about the purity of seed purchased. Johnson grass seed looks something like Sudan grass seed to most folks but is easily distinguished by a trained seed analyst. One insurance against obtaining contaminated Sudan grass seed is to buy seed from a well-informed, reliable seed dealer.

Sudan grass and soybean mixtures.—Soybeans and Sudan grass may be sown in a mixture for green feed, hay, or pasture. The hay mixture will have a higher feeding value than pure Sudan grass, varying with the soybean content, and the total yield may be as great or greater.

For pasture, the soybeans may add very little to the feeding value, since young Sudan grass is very high in protein; then too, the soybeans do not recover from pasturing as Sudan grass does. In general, it is more satisfactory to grow soybeans and Sudan grass in separate fields.

PASTURING SUDAN GRASS AT WOOSTER

C. F. MONROE AND C. C. HAYDEN

In the spring of 1932, a small lot close to the dairy barn at the Ohio Experiment Station was plowed, and on May 20 this was sown to Sudan grass. This lot had been in permanent pasture for many years and in the last few years had amounted to little more than an exercise ground. The stand of Sudan grass obtained, although satisfactory, was not perfect. When pasturing was started on June 23, the grass was approximately "knee-high". Three Holstein cows were allowed gradually to become accustomed to this pasture. Two of these cows were giving approximately 59 pounds of milk per day and the other cow, 46 pounds. The cows ate the Sudan grass readily and showed apparent relish for it from the first. It became necessary to remove one of the cows from the group in August. Another cow was immediately substituted for her. This change was not caused by the pasture.

As there was only 0.6 of an acre in the Sudan pasture, there was not sufficient pasturage furnished to keep the three cows on this plot continuously. When the Sudan grass was eaten down pretty well and when the cows showed signs of "falling off" in milk, they were changed to an adjacent blue-grass pasture containing 1.6 acres. The periods on the two plots were rather irregular. The days and dates of the periods are given in Table 1. Figures for the average daily milk productions are also given in this table. With one exception, milk production was higher in the Sudan-pasture period than in the previous period on blue grass. The exception was in the production of Cow 397 for the period of July 19 to August 2; the difference was very slight, amounting to 0.6 of a pound.

TABLE 1.—Average Daily Production of Milk, with Dates of Pasturing

Type of pasture	Date	Days	Cow 276 Pounds milk daily	Cow 397 Pounds milk daily	Cow 343 Pounds milk daily	Cow 391 Pounds milk daily
Blue grass.....	June 16—June 22........	7	58.2	59.6	46.2	....
Sudan grass...	June 23—July 5..........	13	59.7	63.3	47.9	....
Blue grass.....	July 6—July 18..........	13	52.4	57.3	44.1	....
Sudan grass...	July 19—Aug. 2.........	15	57.0	56.7	47.7*	43.2*
Blue grass.....	Aug. 3—Aug. 16.........	14	50.6	48.1	....	38.0
Sudan grass...	Aug. 17—Aug. 23........	7	50.7	52.2	....	39.8
Blue grass.....	Aug. 24—Sept. 4....	12	47.6	43.6	....	35.7
Sudan grass...	Sept. 5—Sept. 12..... ...	8	48.3	50.5	....	37.0

*Partial periods.

The cows received feed in addition to that which they obtained from the pasture. Grain was fed at the rate of approximately 1 pound to every 4 pounds of milk produced. When the cows were on the Sudan grass, some hay and sweet-clover silage were fed, principally at the beginning of the Sudan grass periods, in order to prevent sudden changes in the ration. Because of scarcity of pasture in the blue-grass plot it was necessary to feed additional hay; in the period from August 3 to 16, about 20 pounds of sweet-clover silage were fed daily to each cow. During the period from August 24 to September 4, when the cows were again on blue grass, they were fed about all the green soybeans they would eat. This total feed consumption is given in Table 2, together with totals for milk and butterfat production and the average daily production during the entire test.

TABLE 2.—Summary of Feed and Totals of Milk and Butterfat Production

Pasture	Days	Milk	Fat	Test	Grain	Hay	Sweet-clover silage	Average daily Milk	Average daily Fat
	No.	*Lb.*	*Lb.*	*Pct.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Sudan grass...	129	6692.6	217.42	3.25	1634	124	156	51.9	1.69
Blue grass.....	129	6155.9	200.85	3.26	1632	241	760*	47.7	1.56
Difference favors Sudan pasture......	....	536.7	16.57	—0.01	2	—117	—604	4.2	0.13

*Green soybeans also fed for 12 days, not weighed.

Although it is probably not fair to compare the milk yields of Sudan grass and blue-grass pasture for the late summer period because blue grass yields little or no pasture during this time, the comparison shows quite distinctly the value of Sudan grass for this period. If the results of this trial are calculated to an acre basis, the total production of the cows while on Sudan grass is 11,154 pounds of milk and 362 pounds of butterfat. One acre of Sudan grass would give 215 cow-pasture days. Of course, these were liberally-milking cows receiving a normal amount of grain (1 to 4) and occasionally a very small amount of roughage.

The fact that the Sudan grass was able to support heavy milk production may be explained in part on the basis of the quality of the feed furnished. For not only did this pasture yield well, but it also furnished a feed high in protein. A partial analysis of the grass at three different dates is shown in Table 3. These figures are for the immature grass as cropped off by the cows and not for the Sudan plant at three different stages of maturity.

TABLE 3.—Partial Analysis of Sudan Grass as Pastured—1932

	June 23	August 22	September 9
	Pct.	*Pct.*	*Pct.*
Moisture	83.4	75.3	73.8
Dry matter	16.6	24.7	26.2
*Protein	23.44	18.19	20.63
*Calcium (Ca)	0.461	0.639	0.550
*Phosphorus (P)	0.301	0.297	0.491

*Air-dry basis.

These results are in general agreement with those obtained at other places. In 1930, 5 acres of Sudan grass on the Hamilton County Experiment Farm (Ohio)[1] furnished pasture for 23 cows for 53 days. This was quite remarkable for that year because of the extreme drouth.

Although the Sudan pasture season may be shortened somewhat in the more northerly locations, the work at Wooster, herein reported, and that reported for Michigan[2] indicate that this crop has possibilities in these regions.

If Sudan grass is to be pastured after a heavy frost, care should be exercised because of the danger of prussic acid poisoning. There may be danger after light frosts also. In some instances poisoning has been reported during severe drouth when growth became stunted or had practically ceased. In the Ohio work there were no unfavorable effects noted. However, if there is any doubt, it may be well to test out the pasture at times by "turning in" the least valuable animal of the herd for a day or so before "turning in" the entire herd.

Fig. 1.—Cows pasturing in Sudan grass in August when other pastures are dry and brown

On many dairy farms, because of the "lay of the land", the pasture is of a permanent nature. Experience has shown that very generally during July and August permanent pastures furnish little eating and that cows on these pastures will show quite marked decreases in milk yield unless given a sufficient amount of supplemental feed. As a cheap feed for July and August, Sudan grass pasture, therefore, appears to have merit.

[1]Cutler, J. S. and W. E. Weaver. 1932. Ohio Agr. Exp. Sta. Bimo. Bull. 156.
[2]Dorrance, A. B. 1931. Mich. Agr. Sta. Quar. Bull. 13: No. 4.

THE CORN AND SOYBEAN COMBINATION

H. L. BORST AND J. B. PARK

An experiment to determine the value of growing corn and soybeans together was conducted at Columbus from 1919 to 1929, inclusive. After 3 years of preliminary work, the method decided upon was to drill both the corn and the soybeans at the same time and at three rates of planting.

The desired spacing of plants and the actual average spacing secured were as follows:

	Corn Spacing—inches		Soybeans Spacing—inches	
	Desired	Obtained	Desired	Obtained
Thick	7 to 8	9.3	2 to 2.5	3.3
Medium	14	14.9	4 to 5	5.4
Thin	22	21.5	9	12.9

An experiment with varieties of soybeans had indicated that Peking made a good growth in corn, stood up best of all the varieties, and was desirable for silage because of its late maturity. Manchu appeared desirable for hogging because of its high yield of seed. The choice would hardly be different now.

The approximate amounts of seed of the two varieties of soybeans sown to obtain the desired stands were as follows:

	Pounds of seed per acre	
	Manchu	Peking
Thick rate, seeds spaced 2½ inches	21	9
Medium rate, seeds spaced 4-5 inches	12	5
Thin rate, seeds spaced 9 inches	6	2.5

In five of the years the experiment was conducted on Miami silt loam, the light colored soil of central and western Ohio, and in 3 years on Brookston, the dark soil of that region.

Four-row plots 75 to 100 feet long were used, usually in triplicate. One-half of each plot in which soybeans were included was planted with Peking, to be harvested with corn at the silage stage, and one-half with Manchu, to be harvested when mature in order to measure the value of the combination for hogging off. No animal feeding was done in this experiment.

VALUE OF THE COMBINATION FOR SILAGE

Soybeans planted with corn reduce the yield of corn forage.—The yields of forage (both green and air-dry weights), of total digestible nutrients, and of protein and the percentages of protein in the fodder are given in Table 1.

TABLE 1.—Corn and Soybeans for Silage

Acre Yields of Forage, Total Digestible Nutrients, and Protein

8-year average

Combinations	Green weight total	Air-dry weights: Corn	Air-dry weights: Soybeans	Air-dry weights: Total	Total digestible nutrients‡: Total	Total digestible nutrients‡: Increase†	Protein: Total	Protein: Increase	Nitrogen in soybeans
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Soybeans alone, spaced 2-3 in., in rows 28 in. apart	18,030	....	4900	4900	2630	....	574	....	92
Corn planted at thick rate—spaced 9 inches									
Corn alone	22,050	8030	....	8030	4710	....	281	....	....
Corn + soybeans thin*	23,010	7490	620	8110	4720	10	334	53	12
Corn + soybeans medium*	23,850	7130	1130	8260	4780	70	382	101	21
Corn + soybeans thick*	23,580	6630	1460	8090	4670	....	403	122	27
Corn planted at medium rate—spaced 15 inches									
Corn alone	20,600	7650	....	7650	4480	....	268	....	....
Corn + soybeans thin	21,450	6700	820	7520	4370	....	331	63	15
Corn + soybeans medium	22,670	6220	1570	7790	4490	5	402	134	29
Corn + soybeans thick	23,870	6160	1990	8150	4680	200	449	181	37
Corn planted at thin rate—spaced 22 inches									
[illegible]	17,[illegible]				3510				
[illegible]	20,[illegible]	[illegible]			3950		352	14[illegible]	25
[illegible]rn + soybeans thick	22,050	4620			4190		484	27[illegible]	31

*Rates of planting soybeans.
Thick—plants spaced 3 inches.
Medium—plants spaced 5 inches.
Thin—plants spaced 13 inches.

†Increase over corn alone at that rate.

‡Calculated from analyses reported by Henry and Morrison.

The data show that wherever soybeans were planted with corn the yields of corn were reduced and that the thicker the soybeans were planted the greater was the reduction in yield of corn. In general, also, the thinner the rate of planting the corn, the greater was the reduction in yield of corn caused by soybeans planted at any given rate.

Green weight yields of silage are misleading.—The green weights indicate that corn and soybeans outyielded corn alone when they were compared at the same rates of planting. On the air-dry basis, however, the increases in yield were either small or lacking. This is explained by the fact that the soybean plants contained more moisture when harvested than the corn, resulting in a higher moisture content in the mixture than in the corn alone. Part of the apparent increase in yield was due to the presence of water. For this reason, air-dry weights are a much better measure of yield than green weights.

No practical increase in silage from the combination.—With corn drilled at the thick rate (9 inches), soybeans produced no increase of practical value in the yield of air-dry material in the silage. With corn planted at the medium rate, soybeans produced a small increase; and with corn at the thin rate (a rate too light for practical farm use), the soybeans increased the yield of air-dry material significantly. It appears that the thicker the corn is planted for silage, the less is the advantage of planting soybeans with it.

When corn is planted too thin for a maximum crop, growers can increase their total silage yields by planting a suitable variety of soybeans with the corn, provided that the soybeans are planted thick enough and that methods of harvesting are such as to save the soybeans. If the corn is planted thick enough to utilize the soil fully, the planting of soybeans with the corn does not significantly increase the total yield of air-dry material.

Since the combination gave no increase in yield over corn alone when corn was planted at the best rate, the question then arises: Do the soybeans improve the quality of the silage either in total digestible nutrients or in protein content?

No practical increase in digestible nutrients from the combination.—Certain combinations of medium and thin corn with soybeans produced a slightly increased yield of total digestible nutrients as compared with corn alone at those rates but did not equal the yield of nutrients from corn alone at the thick rate. Therefore, the virtue of the combination, if it has any, lies in its increased protein production.

Slight increase in protein from the combination.—The mixture from the highest yielding combination (corn thick, soybeans medium) contained, on the air-dry basis, a little over 1 per cent more protein than corn alone planted at the same rate. The increased yield of protein here was about 180 pounds per acre over corn alone planted at the medium rate.

On an acre basis these increases in protein yield may be worth the extra trouble. One hundred pounds of protein are nearly the equivalent of 250 pounds of 40 per cent cottonseed meal. It should be noted, however, that this protein was carried in about 9 tons of silage and is an amount so small that its effect would be hardly detectable in a daily ration of 30 pounds per cow.

TABLE 2.—Acre Yields of Total Digestible Nutrients in Grain from Corn and Soybeans Grown Together
7-year average

Combinations	Grain†			Total digestible nutrients			Protein			Increases‡
	Corn	Soybeans	Total	Corn	Soybeans	Total	Corn	Soybeans	Total	
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Soybeans alone, spaced 2-3 in., in rows 28 in. apart	....	1178	1178	....	1110	1110	....	391	391	....
Corn at thick rate—spaced 9 inches										
Corn alone	2912	....	2912	2380	....	2380	207	....	207	....
Corn + soybeans thin*	2724	126	2850	2230	120	2350	193	42	235	28
Corn + soybeans medium*	2486	256	2742	2030	240	2270	176	85	261	54
Corn + soybeans thick*	2297	336	2633	1880	320	2200	163	112	275	68
Corn at medium rate—spaced 15 inches										
Corn alone	3153	....	3153	2580	....	2580	224	....	224	....
Corn + soybeans thin	2911	190	3101	2380	180	2560	207	63	270	46
Corn + soybeans medium	2578	355	2933	2110	330	2440	183	118	301	77
Corn + soybeans thick	2509	389	2898	2050	370	2420	178	129	307	83
Corn at thin rate—spaced 22 inches										
Corn alone	2658	....	2658	2170	....	2170	189	....	189	....
Corn + soybeans thin	2449	322	2771	2000	310	2310	174	107	281	92
Corn + soybeans thick	2051	640	2691	1680	600	2280	146	212	358	169

*Rates of planting soybeans.
Thick—plants spaced 3 inches.
Medium—plants spaced 5 inches.
Thin—plants spaced 13 inches.

†Shelled corn 15% moisture.

‡Increases over corn alone at same rate.

VALUE OF THE COMBINATION FOR GRAIN

Less grain and nutrients from the combination.—In all the combinations used the soybeans reduced the yield of corn grain below the yield of corn alone planted at the same rate. In no case did the yield of soybeans in the mixture compensate for the loss of corn grain that they caused, except with the thinly planted corn where a small increase of mixed grain was obtained Total digestible nutrients behaved in a similar manner; only with the thinly planted corn did the mixed crops produce more nutrients than corn alone. As previously pointed out, the thin rate used for corn was not a practical farm rate, because the corn does not fully utilize the soil. Therefore, any value that the combination may have depends upon the additional protein produced.

Protein increased slightly.—Soybeans planted with corn at any of the three rates increased the acre production of protein in the grain as compared with corn alone at that rate, the greatest increase coming from the thickest rate of soybeans in each case.

The increases in protein from the combinations of soybeans with either thick or medium corn ranged from about 45 to 80 pounds per acre. These increases were accompanied by losses in total digestible nutrients ranging from practically none to 160 pounds per acre. The desirability of using the combination will be determined by the relative values of protein and other feeds and by the farmer's ability to utilize the soybeans by pasturing with hogs, cattle, or sheep.

The experiments reported herein have had to do only with the amounts of feed materials produced. Experiments on utilization of the materials in feeding trials have been reported by Robison of the Ohio Station.[1] He found that pigs on standing corn containing soybeans usually gained more rapidly and produced more gain per bushel of corn consumed than similar pigs on standing corn alone. He did not report pork production per acre. Weaver, of the Missouri Station[2], reports that hogs harvesting corn and soybeans produced more pork per acre, made more rapid gains, and required less feed per hundred pounds gain than did hogs harvesting corn alone.

It has been found necessary for best results to supply a suitable mineral supplement to hogs on corn and soybeans. An inexpensive mixture is salt 1 part, ground limestone 2 parts, and bone meal 2 parts.

FERTILITY VALUE OF SOYBEANS GROWN WITH CORN

It is of interest to know to what extent growing soybeans with corn is justified by the nitrogen left on the land by the soybeans. Experiments with soybeans grown alone and farm experience indicate that when only the roots and stubble are left on the land there is little or no benefit to the succeeding crop, although exceptions to this are sometimes noted. When the whole soybean crop is left on the land important amounts of nitrogen are added, depending upon the thickness of the stand and the total growth. A good stand of soybeans in corn amounts to 1000 to 1200 pounds of air-dry material containing 30 to 35 pounds of nitrogen per acre (See Table 1). This is returned to the soil if the crop is not removed. This is as much nitrogen as is contained in 3 tons of farm manure or in 200 pounds of nitrate of soda.

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[1]Robison, W. L. 1924. Soybeans in corn for hogging-down. Ohio Agr. Exp. Sta. Monthly Bull., Whole Nos. 101 and 102, pp. 75-80.

[2]Weaver, L. A. 1924. Hogging down corn and soybeans. Mo. Agr. Exp. Sta. Bull. 224.

SUMMARY

Soybeans grown with corn always reduced the yield of corn, either silage or grain, as compared with corn planted alone at the same rate.

When corn alone was planted thick enough to make a maximum yield, the addition of soybeans as a combination crop did not increase the yield of dry material or of total digestible nutrients at the silage stage but did increase the protein slightly. When corn was planted too thin to utilize the soil completely, the presence of soybeans increased the total yield of material.

Corn alone, when planted thick enough to make a maximum yield, produced as great a yield of total digestible nutrients in the grain as any combination of soybeans with corn.

The most favorable combination gave an increased yield of protein (46 pounds per acre) with practically no loss of total nutrients.

RAISING CHICKS IN 1933

D. C. KENNARD

That many farmers, as well as "back-to-the-land" city folks, are turning to poultry raising for economic reasons is definitely indicated by the hundreds of letters received and by the many visitors who are coming to the Station (many of them coming from considerable distances) seeking information on poultry raising. Having had little or no experience with poultry raising, they are interested primarily in securing definite, fundamental information based on experience and the application of scientific principles. This article is an attempt briefly to provide information and suggestions not generally emphasized which may assist those inexperienced in poultry raising to avoid some of the frequent causes of failure and, perhaps, at the same time to serve the experienced poultry raiser who may have digressed too far from the fundamentals. In raising chicks in 1933 it will be more important than heretofore that every effort be made to avoid all possible chances of failure.

Perhaps, the most frequent cause for failure among beginners is the popular impression that poultry raising is a simple procedure and that almost anyone, even without experience, can succeed. Experience, on the contrary, shows that many beginners fail and, what is worse, that they often lose their savings invested in the undertaking. This is particularly true of those not content to secure their first-hand experience on a small scale. When the venture is started on a small scale, failure may not prove a serious matter. If success attends the first venture, then the poultry raiser can gradually increase his operations accordingly.

Just what may be regarded as small- and large-scale ventures for beginners vary with individuals in accordance with their disposition, aptitude, financial position, etc. For the average beginner, one or two 10 x 12 foot or 12 x 12 foot colony brooder houses, to accommodate the number of chicks suggested below in accordance with the method of brooding that may be employed, would be generally sufficient to start with. If reasonably successful, each three chicks should yield one select pullet for the laying house in the fall. If

all equipment must be provided new, then a laying house may be built and first used as a brooder house. The size of the laying house may be calculated on the basis of 3.5 square feet of floor space for each layer. When other buildings are available, they may often be used for brooding and for the layers rather than involving the expense of new buildings.

Some of the first and most important objectives for beginners to learn are whether they are going to like the poultry business as well as they anticipated and whether it will yield sufficient returns and the kind of livelihood expected. Obviously, every beginner should secure the answer to these questions by means of small-scale operations involving a minimum of capital before attempting larger undertakings not warranted by his experience or working capital.

METHODS OF PROCEDURE

In proceeding to raise chicks there is a considerable number of factors to be taken into consideration. About the first question that faces the 1933 poultry raiser is whether he shall purchase day-old chicks or hatch his own chicks. Generally, it is advisable for beginners to purchase day-old chicks, since it is a sufficient undertaking to brood chicks for the first time. Inasmuch as chicks of high quality can be readily obtained in practically all localities at reasonable prices, it is often questionable whether it is an economical proposition for the individual poultryman, even if experienced, to attempt to do his own breeding and hatching. The next question is: "When shall the chicks be obtained?" The chick season has been greatly extended of late years so that, in a general way, it begins with January and ends with May. For various reasons, the earlier chicks can be obtained the better. The early chicks are generally easier to brood because temperature control in the brooder house is a more simple matter during cold weather than during warm weather. Furthermore, early-hatched chicks are usually less subject to disease and parasites, because they seem to have greater vigor than later-hatched chicks and, also, conditions are less favorable during cold weather for the propagation of disease and parasites than during warm weather. The special requirements for early chicks are: (1) That the brooder house and the brooders be capable of keeping chicks comfortable, regardless of the severity of the winter weather, and (2) that, since the chicks must be confined indoors much of the time, they must be fed a complete ration. Many find it a desirable procedure to secure chicks in January and again in May, so that the same brooding equipment can be used twice during the season. This also has the advantage of having the pullets coming into production in July and October and, thus, producing a more steady supply of eggs.

METHODS OF BROODING AND REARING

1. **The range method.**—In this method, the chicks have access to an unlimited range after the first 2 or 3 weeks, which necessarily means that the chicks must be hatched in March, April, or May. This method has some advantages in that more chicks can be raised in a given brooder house and they will thrive on a more simple ration. Since the range provides the necessary green feed and sunshine, these factors need not be provided in the ration. The range method, at the same time, has its disadvantages; among these are the hazards of contaminated soil (it requires fresh, clean range for each group

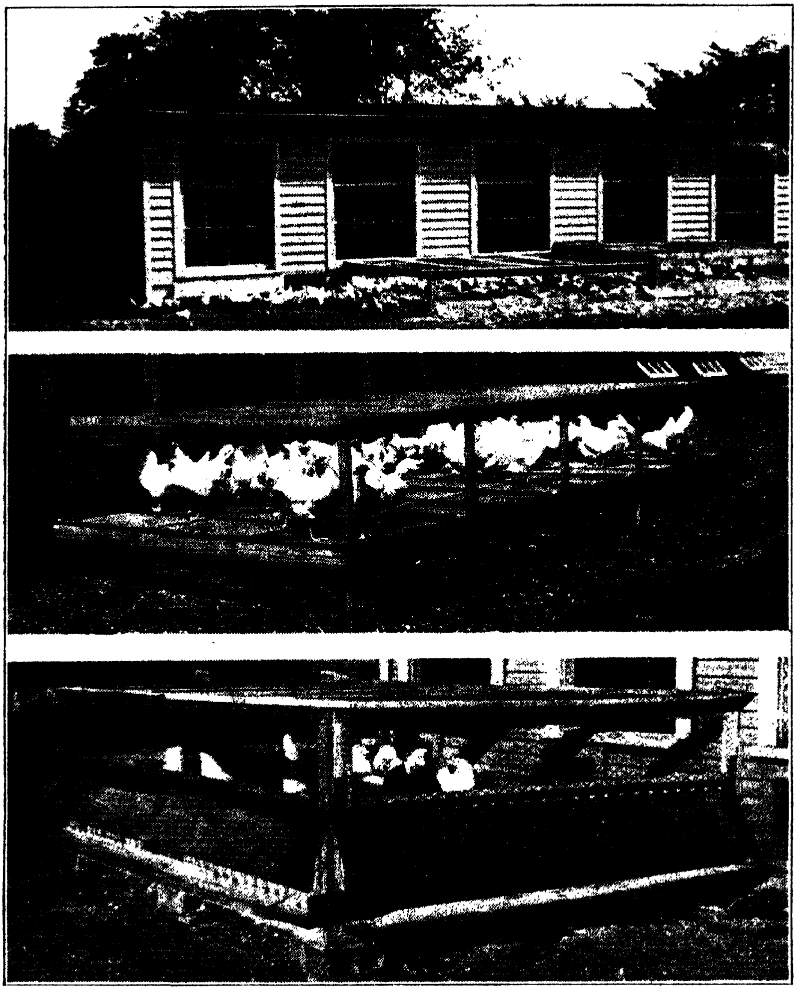

Fig. 1, Top.—A test in progress at the Station with chicks on range (left), in slag sun yard (middle), and in screen sun parlor (right).

Middle.—A wire-screen sun parlor for layers. In this case, instead of feeding outside, the birds are driven out into the sun parlor and kept outside for one-half hour daily at noon when weather permits in winter, and at 8:00 A. M. or 4:00 P. M. during summer months, so that every bird will receive the benefits.

Bottom.—Chicks started on wire-screen floor in brooder house and continued as layers in the same quarters for 1 year. When the birds receive all feed and water outside, they need to be protected against the hot sun during the summer months. A single thickness of burlap stretched over the top of the sun parlor will serve this purpose and will admit sufficient direct sunlight.

of chicks), the inconvenience or impracticability of moving brooders to fresh range, the frequent losses from predatory animals, and the possible losses of chicks from being caught outside by a sudden storm or downpour of rain.

2. **Brooding chicks in confinement and ranging the pullets.**—The chicks are brooded in confinement during the first 6 to 10 weeks while they need artificial heat. Then the pullets are transferred to suitable colony houses or range shelters on summer range, where they are developed until they are ready for the laying house. This has recently become a popular method with many poultry raisers. The advantages are: (1) Because the chicks are confined during the brooding stage, the brooding equipment can be permanently located close to the residence where it is more convenient to give the chicks the necessary care; (2) there is lessened liability of ills from contaminated soil; and (3) the chicks, being confined, are protected against predatory animals and sudden storms. The chief disadvantages are: Reduced capacity of brooding equipment, since only about one-half as many chicks should be put in the brooder where they are to be confined even if they have access to a wire-screen sun porch; and confined chicks are more subject to the vices of feather picking and cannibalism.

3. **Confinement of both chicks and pullets.**—Although this more extreme procedure is quite new, it has already been successfully employed by a considerable number of poultry raisers. In fact, one of the largest poultrymen of Ohio, who raises a large number of pullets each year, has successfully used this method during the past 4 years. Generally, the practice is to use colony brooder houses and wire-screen sun porches. The principal disadvantage of the confinement of pullets during their developmental period is that they are more subject to the vices of feather picking and cannibalism. Severe losses on this account may be experienced, although such losses are largely preventable by proper attention, judgment, and action on the part of the caretaker. There are four means of prevention which this Station has found effective:

a. Provide ample room for confined pullets. (A 10 x 12 or 12 x 12 foot colony house with a wire-screen sun porch will accommodate only 75 confined pullets 3 to 5 months of age). Besides the prevention of losses from vices, ample room promotes a more uniform development of the pullets with a minimum of losses from other causes.

b. Keep pullets comfortable by protecting them from the heat of the sun as much as possible. This may be accomplished by having free circulation of air through the colony house or range shelter, and, in case of a colony house with sun porch, the sun porch should be on the north side. The sun porch also needs to be covered with burlap, straw, or corn stalks to protect it against the heat of the sun, in order to make the porch more comfortable and thus attract the pullets outside where they will realize the full benefits. It is also very desirable to locate the colony house near a shade tree when possible.

c. Keep excess light from entering colony house as much as possible without interfering with the necessary air circulation.

d. A complete ration to meet all requirements for confined pullets and ample feeding and drinking equipment are very essential for best results.

During the past 4 years the Station has conducted tests comparing the three different methods of raising pullets and has found that each of the three methods was successful when the special requirements were adhered to. The vices of feather picking and cannibalism proved to be no special problem, except during the first year before effective measures of prevention and control were known.

Fig. 2.—This laying house was used for brooding chicks in confinement. They were grown and continued as layers in these quarters. The feeding and drinking equipment was placed just inside the windows so as to insure exposure to sunlight, thus avoiding the use of cod-liver oil until November 1. This method of management proved highly successful.

PREVENTABLE TROUBLES

Brooding chicks is often attended with serious losses from causes which are largely preventable, particularly the vices of feather picking and cannibalism. The most frequent cause of these troubles is overcrowding the chicks; hence, one of the first essentials in attempting to raise chicks is to make sure they have ample room. By this is meant that under no circumstances should there be more than 300 to 350 chicks brooded in one group; that is, if a 10 x 12 or 12 x 12 brooder house is used and if the chicks, after they are 2 or 3 weeks of age, are to have free range when the weather permits, then 300 to 350 chicks may be brooded in brooder houses of this size. If the chicks are to be confined indoors or to have access to wire-screen sun porches, the number should be reduced one-half. Other reasons besides the prevention of the vices make it necessary not to exceed these quotas of chicks if best results are to be secured. When ample room is provided, the chicks can be expected to grow more uniformly and be less subject to diseases and other troubles.

FALSE ECONOMIES

Poultry keepers in 1933 will need, more than ever, to keep down overhead costs and to produce pullets economically. To put it differently, false economies, as well as needless expense, must be carefully avoided. Generally, the first temptation will be to purchase chicks on the basis of price rather than quality. This may often mean deliberately choosing between success or failure. It has been well said that "a good chick is half raised". Certainly, it often proves impossible to raise inferior chicks; whereas high-quality chicks often come through without any particular difficulties. Although the price of chicks may not always be an index to quality, the purchaser of chicks must in one way or another make sure of securing quality chicks regardless of their price. If one can satisfy himself that he is getting a better grade of chicks by paying more, there should be no hesitation in paying two or three times as

much for them, even if it means getting only one-half or one-third as many chicks. It may be much more profitable in the end to succeed with 100 quality chicks than to fail with 300 or more inferior chicks.

A frequent temptation, not only for beginners but old timers, is to attempt to get along with inadequate equipment. That is why too many exceed the proper capacity of the brooder house and fail to provide suitable and adequate feeding and drinking equipment. This is another false economy which never pays. Another frequent form of false economy is the neglect of the pullets during the growing period. Frequently, great effort and care are taken to bring the chicks through the brooding period in fine condition; then, when the pullets go out on range they are often required to shift for themselves and the caretaker even neglects to feed them properly. For instance, it is an all too frequent occurrence for pullets on range to receive little else than whole grain, aside from what the range provides. This is a grave mistake; a well-balanced mash should always be kept available for the pullets.

Obviously, success or failure with raising chickens is determined by many essential and contributing factors. Only a few of these factors which appear to be the more common causes of success or failure have been dealt with in this paper. Success is the result of all the many factors functioning normally and effectively.

Those desiring detailed directions and suggestions relative to methods of feeding chicks, feed formulas, wire-screen sun porches, prevention of cannibalism, etc., can obtain the same by addressing a post card request to the Ohio Agricultural Experiment Station at Wooster, Ohio.

LEG DISORDERS OF GROWING CHICKS

R. M. BETHKE AND P. R. RECORD

Under the present system of intensive production many phases of feeding and management of chicks have changed. With these changes a number of new problems has arisen to confront the poultry producer.

Among these problems is that of leg disorders of growing chickens. There are, in general, five different leg disorders which frequently occur. These are listed below with the hope of assisting poultrymen to understand better the causes and occurrences of the disease and to recognize the symptoms and behavior of the birds, which characterize the different complications.

1. **Rickets or true leg weakness.**—This disease is caused by a deficiency of either vitamin D or calcium and phosphorus or both. It seldom, if ever, occurs under ordinary conditions before the fourth week, unless the feed is decidedly deficient in calcium or phosphorus. The first symptoms usually noted are frequent squatting of the birds and disinclination to walk. The feathers become ruffled and the birds become unthrifty in appearance. The bones, due to improper calcification, are soft and easily cut or bent and frequently become enlarged. The ribs also become bent and show enlargement at the cartilaginous connections. The breast bones become crooked. The disorder, as is well known, can be corrected or prevented by adding potent cod-liver oil, or its equivalent, to the ration or by giving the birds access to direct sunlight or ultra-violet light. If the disorder is caused by a mineral deficiency, the addition of lime and phosphorus in the form of bone meal or some other equally effective, lime-containing or lime- and- phosphorus-containing mineral will correct the trouble.

Fig. 1.—Hock disease, slipped tendon, or perosis of chicks

2. **Hock disease, slipped tendon, or perosis.**—This disorder is very commonly confused with rickets or true leg weakness. It makes its appearance usually after the third or fourth week (Fig. 1). The legs of the birds become bowed, or one or both legs will be badly twisted or distorted as a result of the slipping of the Achilles' tendon from its normal position. Usually, the bowing or distortion of one or both legs is accompanied by an enlargement and flattening of the hock joint. The bones are well calcified and hard in comparison to the poorly calcified, soft bones found in the case of rickets.

It has been observed that the birds of the heavy breeds are more susceptible to this disorder than birds of the light, or Mediterranean, breeds. Frequently, it is also noted that a larger percentage of the males than of the females is affected. The condition, to a certain extent, is also associated with rapid growth; however, it may appear in slowly growing individuals. The types of floors on which the birds are brooded also appear to be contributing factors. Wire floors or battery brooder conditions are more conducive to its development than solid floors or outdoor range.

The exact or specific cause of the condition is not definitely known; however, there is considerable evidence that excessive amounts of lime and phosphorus are incriminating factors. The matter of prevention lies in the proper control of the mineral content of the ration and the adjustment of the protein content of the ration so as to reduce the rate of growth. Frequently, the addition of 10 to 20 per cent of ground whole oats or 10 per cent of rice bran will prove beneficial in preventing the trouble.

3. **Crazy chicks.**—The cause of this type of disorder is not definitely known. Some investigators have advanced the theory that it was due to some toxic principle in cod-liver oil and that it could be controlled by the elimination of the oil from the ration. It is doubtful whether this theory is correct, for the trouble has been observed in chicks that did not receive cod-liver oil. As a rule, the disorder makes its appearance under intensive feeding conditions—especially in the case of feeds which induce very rapid growth. It commonly occurs between the second and fourth week and rarely, if ever, after that time. A small or a considerable percentage of the birds may be affected.

The symptoms are of the nature of a vitamin-B, or antineuritic, deficiency. The birds not only lose their balance but also their sense of direction and the proper use of their legs. The afflicted individuals frequently lie on their side or sit on their hocks, with a twisting or retraction of the head.

Fig. 2.—A type of paralysis in growing chicks

Under ordinary conditions, it is difficult to cure the disorder, although some have reported that yeast was effective if the birds were treated during the very early stages. The condition can, as a rule, be controlled in a flock by checking feed consumption and rate of growth, by a radical change in feed, or by adding 15 to 20 per cent of ground corn or wheat bran to the ration for one or 2 weeks.

4. **Nutritional paralysis.**—This is in all probability associated with a partial deficiency of the vitamin-G complex. It usually makes its appearance after the third week and is frequently confused with rickets or slipped tendon.

The affected birds can only use their legs with great difficulty and generally walk upon their hocks (Fig. 2). Their toes curl inward, and frequently the birds walk upon the distal end of the tarso-metatarsus. In advanced cases the birds lie upon the floor with legs extended in opposite directions. The leg muscles are flabby and without tone. In some cases the skin of the legs and toes of the affected chicks is dry and rough. It is distinguished from slipped tendon or hock disease in that no enlargement or flattening of the hock joint, bowing of the legs, or displacement of the Achilles' tendon is noted. It is distinct from rickets in that additional vitamin D or minerals will not prevent or correct the condition. The bones of the affected birds are normally calcified in contrast to improperly mineralized bones in the case of rickets. A certain percentage of the paralyzed chicks gradually recovers without treatment and cannot be distinguished from non-afflicted individuals, except that in some cases the toes will remain curled.

The prevention of the disorder from the practical standpoint lies in the liberal use of milk products in the ration. Green feeds, such as good quality legume meals, are also effective but not as efficient as milk. The most potent sources of the paralysis-preventing factor are beef and pork liver and yeast.

5. **Range or fowl paralysis.**—Several hypotheses have been advanced as to the cause of this disorder. None of the explanations, however, appear to cover any or all cases. It is commonly considered that the disorder does not make its appearance until some time after the tenth week. However, within the past year it has been reported as early as the fifth week. The symptoms are lameness, paralysis of one or both legs (with the bird apparently having little or no control of the affected leg), drooping of wings, and blindness. The affected eyes are usually of a grayish-blue color, and the birds are sometimes referred to as "glass-eyed" owing to the abnormal appearance of the pupil.

No specific cure or prevention for the disease is known. It is generally considered that strict sanitation is essential for partial control and prevention. It has also been suggested that the chicks should come preferably from parent stock which is free from the trouble.

Although the symptoms and apparent causes of the five types of leg disorders are quite distinct, the matter of correct diagnosis is frequently difficult, because the pathological or histological changes of the disorders, except for rickets and fowl paralysis, have not been worked out in detail. Correct diagnosis is further complicated by the fact that two of the disorders (for example, nutritional paralysis and slipped tendon) might occur in the same flock or pen simultaneously. It is only through careful study of the nutritional history of the birds and their behavior that a correct solution of the problem can be arrived at.

THE LESSER PEACH BORER

Aegeria pictipes G. & R.

M. A. VOGEL AND R. B. NEISWANDER

The lesser peach borer is a native insect, which, prior to the introduction of cultivated plants such as plum, cherry, and peach, depended for existence upon native drupes. Early records indicate that the greatest damage was done to plums, with occasionally some damage to cherries. However, about 1906 it was noted that the insect evidently was increasing on peach, today its chief host. This species, although generally distributed over Ohio, has developed to proportions of particular economic importance in the peach-growing section along Lake Erie. Thousands of trees are lost each year either directly or indirectly from the work of this pest. If the damage is not sufficiently great to cause the death of the tree, branches may be weakened to such an extent that breakage occurs; in any event, the vitality of the tree or branch is lowered, and this results in impaired productivity.

Fig. 1.—Section of peach tree branch showing work of lesser peach borer

The attacks of this insect are confined almost wholly to injured areas on trunk and branches. The female moth is apparently attracted to the presence of gum or sap flow from wounded areas, where she oviposits. Newly hatched larvae immediately seek out the wounded areas and, when established, feed freely on the growing bark at the edge of a wound. The presence of a larva may be indicated by the large deposit of gum which is usually mixed with excrement pellets.

Unlike the peach tree borer, which works at or below the surface of the soil, the lesser peach borer most generally works in the trunk and branches (Fig. 1). The larva when full grown averages slightly less than an inch in length, thus being smaller than the larva of the peach tree borer with which it frequently is confused.

Life history and habits.—A detailed study of the life history of this insect will be found in Bulletin 307 of this Station.

Control.—Heretofore, preventive, rather than specific, measures have been relied upon, for the most part, in attempts to control this insect. Chief among these have been the adoption of pruning practices which promote the formation of rounded instead of narrow crotches (Fig. 2) and the avoidance of branch stubs; cultural practices intended to minimize the danger of frost cracks and

winter killing; and the avoidance of abrasions to the bark during the course of cultivation or other orchard activities. The measures have aided materially in effecting orchard control, since it is a well established fact that any break or roughened area in the bark offers an easy means of entrance for the borer.

Fig. 2.—Proper and improper plans for training peach trees

Trees with open, smooth crotches are seldom attacked by lesser peach borers and less frequently are split during storms or by the weight of ripening fruit. A trunk 15 to 20 inches high gives ample room for the use of the cultivator, therefore lessening a large amount of mechanical injury caused by scraping the trunk and branches.

The deep crevices formed by sharply angular crotches form ideal lodging places for the larvae of the lesser peach borer. This type of crotch is also easily split during storms or by weight of a large crop. The large pruning scars are also commonly infested with borers or rotted by fungi.

However, regardless of the care used in exercising known preventive measures, many borers succeed in establishing themselves, and the wounds so made prove susceptible to the activity of other borers. Some orchardists have utilized the "digging out" process for destroying established borers, but this is only moderately successful and it also further wounds the tree. Moreover, it is laborious and expensive.

During the autumn of 1930, O. I. Snapp, Entomologist with the Federal Bureau of Entomology, reported success in killing the lesser peach borer by using paradichlorobenzene dissolved in crude cottonseed oil at the rate of 1 pound of the chemical to 2 quarts of the cottonseed oil.

Accordingly, it was decided in the spring of 1931 to try this material under Ohio conditions. In preparing this solution the cottonseed oil was heated and the paradichlorobenzene slowly stirred in. It was then stored in tightly covered containers until applied. The orchard selected for the work belonged to the U. S. Gypsum Co., at Gypsum, Ohio, and consisted of Elberta trees approximately 15 years old. Treatment consisted, first, of scraping away all gum and frass and, then, of applying the material with a paint brush to the infested areas. The results of this test are shown in Table 1.

TABLE 1.—Results in the Control of the Lesser Peach Borer—1931

Treatment	No. of trees	Date treated	Date examined	Total larvae and pupae found		Efficiency
				Alive	Dead	Per cent
PDB*............. 1 lb. CSO†............. 2 qt.	10	4/23	5/20-21	6	17	72.34
PDB.............. 1 lb. CSO .... 2 qt.	29	5/4	5/20-21	7	21	73.41
PDB .... 1 lb. CSO................ 1 qt.	7	5/4	5/20-21	1	7	85.64
Untreated.	2	....	5/5	5	1	....
Untreated................	17	....	5/20-21	41	0	....

Mortality on untreated trees—2.12%.
*Paradichlorobenzene, also marketed under the names PDB, Paradow, Paracide, etc.
†Crude cottonseed oil.

Difficulty was experienced in getting 1 quart of crude cottonseed oil to absorb 1 pound of paradichlorobenzene; hence, in some of the tests a larger proportion of oil was used. The results indicate, however, that the stronger solution is slightly more efficient.

It is believed that if the treated trees had been examined within a shorter period after treatment the results indicated would have been better, since, undoubtedly, some small larvae died and their bodies disintegrated before the record was taken. This belief is strengthened by the fact that a total of only 1.26 borers was accounted for in the treated trees; whereas the untreated trees averaged 2.47 borers per tree. For these reasons it is thought that the results indicated probably underemphasize the degree of efficiency of the treatments. On the whole, the results were quite gratifying, and the material seemed worthy of continued trial.

In the spring of 1932 paradichlorobenzene, at the rate of 1 pound of the chemical dissolved in 2 quarts of cottonseed oil, was used exclusively. The material was applied liberally with a paint brush to the infested areas without removing the frass or gum. The results are given in Table 2.

TABLE 2.—Results in the Control of the Lesser Peach Borer—1932

Treatment	No. of trees	Date treated	Date examined	Total larvae and pupae found		Efficiency
				Alive	Dead	Per cent
PDB.......... .... 1 lb. CSO.............. 2 qt.	40	4/18	5/2-3	12	107	87.62
PDB.............. 1 lb. CSO.............. 2 qt.	31	5/2	5/11-12	6	96	91.71
Untreated.................	37	....	5/2-3	223	5	....
Untreated.................	16	....	5/12	44	2	....

Mortality on untreated trees—2.55%.

It will be noted that the results of 1932 excelled those of 1931 and that a greater degree of efficiency was indicated when examinations were made 10 days after treatment than when a 15-day period was allowed to elapse.

Conclusions.—Paradichlorobenzene dissolved in crude cottonseed oil, at the rate of 1 pound of the chemical to 2 quarts of the oil, has proven an efficient means of controlling the lesser peach borer.

Infested areas only should be treated, and the application should extend an inch or two beyond the edges of borer indications. The infested areas should be thoroughly soaked with the insecticide.

Applications should be made preferably during March or April as fall applications have not proven so satisfactory.

No injury has been apparent on any of the trees treated.

In cold weather it may be necessary to warm the oil in order to dissolve all the crystals.

This insecticide may be made up ahead of the time it is to be used if it is stored in an air-tight container.

The treatment is relatively inexpensive as compared with the now obsolete "digging out" method of control. Paradichlorobenzene can be obtained from any of the larger insecticide houses in Ohio, but it may be necessary to send to one of the cotton processing plants of the Southern States for the needed supply of crude cottonseed oil. Ordinarily, the oil can be obtained for as little as 60 to 75 cents per gallon.

It is well to bear in mind, however, that, although the new method of control possesses great merit, other measures intended to prevent infestation should not be overlooked.

RURAL OHIO'S CONTRIBUTION TO ROAD FINANCE

JOHN F. DOWLER

Roads have been improved very rapidly during the past two decades. Of the roads in the state system of highways in 1914, one-third of the mileage was earth[1]; whereas in 1931 earth roads constituted only three-quarters of one per cent[2]. Likewise, much improvement has been made on other roads in the State but perhaps not as much as on the state system.

Previous to the gasoline tax, the main burden of road support was borne by uniform tax levies and special assessments on real estate. From 1921 to 1925 this amounted to 75.7 per cent[3] of the funds raised for roads. In 1931 real estate and property produced 45.8 per cent of such funds by uniform tax levies and special assessments, as shown in Table 1. These levies and special assessments were made by the counties and townships. There has been no state uniform tax levy for roads since 1922. Special assessments on state roads have been collected through local counties and appear as county funds.

The Federal government contributed $9,170,528 for road construction in Ohio in 1931; this is 10 per cent of the funds used in the State for roads and is larger than in any previous year. In 1929 and 1930 the amount was less than $5,000,000 per year. Federal funds are used only on "federal aid roads" in the state system. The sources of federal funds are from collections of internal revenue and custom duties. This revenue cannot be allocated directly to Ohio citizens as contributors; they pay their share indirectly and receive some return benefit in the form of federal aid for roads.

The revenue spent by the State government in 1931 for road construction and maintenance came from appropriations made out of gasoline excise tax, motor vehicle licenses, and motor bus fees and amounted to $30,712,511, or 33.6 per cent of the total support of roads in the State.

The counties also received revenue from motor vehicle licenses, and both counties and townships received revenue from the gasoline excise tax for the support of their roads. These funds amounted to $10,749,167, or 10.6 per cent of the total road funds. Support for streets of municipalities has not been included in the figures given in Table 1.

The sources of road support in the State, other than municipal streets, are given in Table 1. The question arises—Can the contribution by the rural portion of Ohio citizens be separated from other payments?

The division of uniform tax levies has been made between incorporated and unincorporated territory. Unincorporated territory through the general property tax contributed 16.0 per cent of all revenue collected for roads. Practically all of the special assessments on real estate abutting or near road improvements are on property outside of incorporated places. If we use only 90 per cent of these assessments, they would amount to 9.5 per cent of the total road revenues; this amount added to that obtained from uniform tax levies (16.0 per cent) gives 25.5 per cent, which is the portion of the total road

[1]Survey of Transportation. 1927. Bureau of Public Roads, U. S. Dept. Agr. and Ohio Dept. of Highways and Public Works, P. 17.

[2]State, County and Township Public Road Mileage. 1931. Ohio Dept. of Highways.

TABLE 1.—Tax Revenue Collected for State, County, and Township Roads in Ohio, 1931

Levying jurisdiction	Uniform tax levy on property				Special assessments on real estate abutting or near road improvement (3)		Other tax revenues (4)		Total (5)	
	Outside municipal corporations (1)		In municipal corporations (2)							
	Dol.	Pct.	Dol.	Pct.	Dol.	Pct.	Dol.	Pct.	Dol.	Pct.
Federal government (road construction)	....	....	....	....	....	....	9,170,528	10.0	9,170,528	10.0
State (construction)	....	....	....	....	....	....	15,069,819*	16.5	15,069,819	16.5
State (maintenance and repair)	....	....	....	....	....	....	15,642,692†	17.1	15,642,692	17.1
County (construction, maintenance, and repair)	3,989,848	4.4	11,905,959	13.0	8,728,215	9.5	7,498,896†	8.2	32,122,918	35.1
County (road debt payment)	1,923,471	2.1	5,739,760	6.3	....	....	....	....	7,663,231	8.4
Township (construction, maintenance, repair, and road debt payment)	8,688,814	9.5	....	....	887,067	1.0	2,250,271*	2.4	11,826,152	12.9
Total	14,602,133	16.0	17,645,719	19.3	9,615,282	10.5	49,632,206	54.2	91,495,340	100.0

*Gasoline excise tax.
†Motor vehicle licenses and a portion of gasoline tax.
Note—Information derived from Annual Report, Ohio Tax Commission, 1930; Auditor's Report for Ohio; and records in Bureau of Inspection and Supervision of Public Offices, in Auditor's Office, Columbus, Ohio.

revenues that was contributed by property owners in the country through uniform tax levies and assessments. The indirect taxes included in Column 4 of Table 1 cannot be so accurately divided. They include federal internal revenue and custom duties, state gasoline excise tax, motor vehicle licenses, and motor bus fees, which may be divided on the basis of population. Such a division would add 13.5 per cent to the 25.5 per cent. The resulting 39.0 per cent represents approximately the portion of road costs that has been paid by persons outside incorporated territory in 1931.

Such a figure has been worked out by H. R. Moore[3] for the period 1921 to 1925. At that time the rural people paid 48.5 per cent of the road costs. Thus, there has been a decline in the percentage of the total road costs paid by rural people, but in actual dollars the people in the open country paid $35,614,206 for road support in 1931 as compared with an average of $26,540,170 per year during the period of 1921-1925, or an increase of over 34 per cent.

In 1931, 75 per cent of Ohio's population lived in incorporated territory, owned 73 per cent of the motor vehicles, and contributed about 61 per cent of the revenue expended on the public highways. The 25 per cent of Ohio's population that lived outside of incorporated territory owned 27 per cent of the motor vehicles and contributed approximately 39 per cent of the revenue.

[3]Moore, H. R. 1927. Road Support vs. Road Use. Ohio Agr. Exp. Sta. Bimo. Bull. 129.

TRENDS IN FARM TAXES, PRICES OF FARM PRODUCTS, AND FARM REAL ESTATE VALUES

H. R. MOORE

In 1900, taxes paid on all farm property in Ohio averaged $0.49 per acre, farm real estate had an average value of $42.00 per acre, wheat sold at $0.71 per bushel, and the prices of other farm products were on a proportionate level. From 1900 to 1915 the trends in taxes, real estate values, and farm products prices were remarkably similar. Events since 1915 have upset this pre-war balance which, for purposes of price comparisons, is usually considered as normal. Farm taxes rose steadily to a peak of $1.70 per acre in 1929, 238 per cent of the pre-war price; prices of farm products fluctuated from the peak of 218 in 1919 to the low of 63 per cent of the pre-war price in 1932; farm real estate values reached the high point of 159 in 1920 and receded to 70 per cent of the 1913 price—approximately $55.00 per acre—in the first 6 months of 1932.

Following 1920, the net income from the land has been adversely affected by the relatively low price of farm products and by high farm taxes. Since 1929 the price of farm real estate has lagged behind the rather precipitous drop in the price of farm products. This lag might be caused entirely by marketing forces moving more slowly when applied to real estate, but the eventual effect of reduced taxes should not be ignored. The property tax expense of Ohio farmers averaged $1.21 per acre in 1932, which was $0.49 per acre less than 3

years before. This is a sharp reversal in tendency in property taxation. Provided the current plans for further revision of the tax system in Ohio can be continued, farmers have good reason to hope for further reduction in farm taxes.

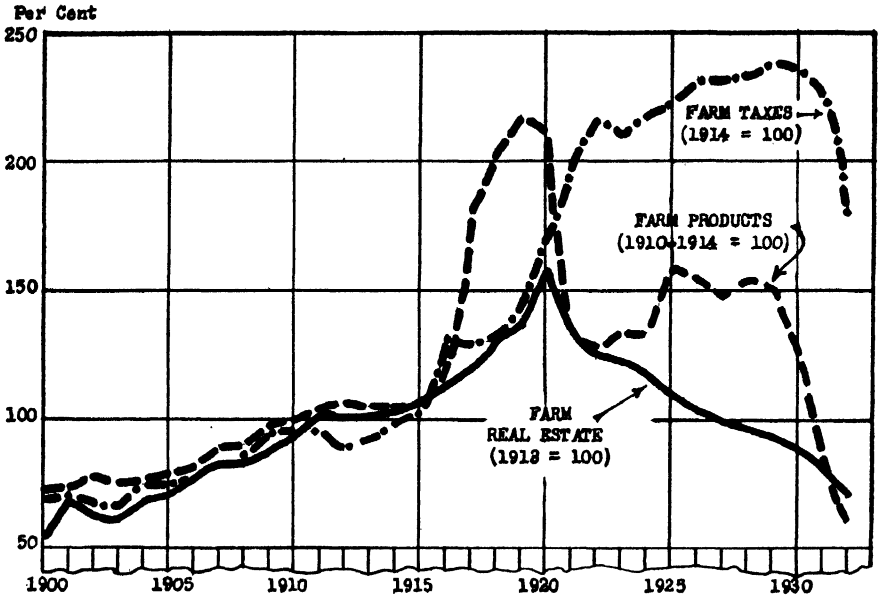

Fig. 1.—Indexes of farm taxes paid, price of farm products, and price of farm real estate—Ohio, 1900 to 1932

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Crops yields per acre in Ohio for the year 1932 averaged 3 per cent below the 10-year average; the total volume of agricultural production was 7 per cent below, and the agricultural income was 56 per cent below. Prices which showed some inclination to rise in the summer had lost this gain by the end of the year. The continued price decline for the past 4 years has brought to the forefront the mortgage debt problem. Lower land values have decreased the owner's equity. As compared with the years 1927 to 1929, it now takes three times the volume of wheat, corn, or hogs to pay the same amount of interest. The debt problem has now become one of national interest.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	99	100	101	102	102	102	105	107
1915........	102	101	106	100	103	107	106	110
1916........	125	114	123	117	113	113	121	121
1917........	172	129	150	176	140	119	182	198
1918........	192	160	178	200	175	131	203	243
1919........	202	185	205	209	204	135	218	266
1920........	225	222	206	205	236	159	212	242
1921........	142	203	156	116	164	134	132	136
1922........	141	197	152	125	145	124	127	136
1923........	147	214	153	135	166	122	134	149
1924........	143	218	154	134	165	118	133	150
1925........	151	223	159	146	165	110	159	164
1926........	146	229	156	136	170	105	155	176
1927........	139	231	154	131	173	99	147	163
1928........	141	232	156	139	169	96	154	147
1929........	139	236	155	138	169	94	151	161
1930........	126	226	146	117	154	90	128	130
1931........	107	207	129	80	120	82	89	93
1932........	94	....	110	57	92	....	63	67
1931								
January...	114	212	137	94	133	....	104	115
February.	112	215	136	90	....	....	96	85
March.....	111	219	134	91	....	82	98	104
April......	109	215	133	91	119	....	102	97
May.......	107	211	130	86	....	....	96	90
June.......	105	207	129	80	....	....	92	93
July.......	105	207	128	79	115	....	84	86
August....	105	207	127	75	....	....	86	90
September	104	205	124	72	....	....	82	87
October...	103	199	122	68	116	....	77	86
November.	102	196	120	71	....	....	79	93
December..	100	194	119	66	....	....	72	88
1932								
January...	98	191	118	63	100	....	69	81
February..	97	189	116	60	....	....	64	68
March.....	96	189	114	61	....	70	64	67
April......	95	183	113	59	94	....	64	65
May.......	94	177	112	56	....	....	61	63
June.......	93	174	110	52	....	....	59	61
July.......	94	171	109	57	90	....	63	67
August....	95	172	108	59	....	....	66	73
September.	95	177	107	59	....	....	64	67
October....	94	177	107	56	84	....	61	68
November.	93	171	106	54	....	....	61	66
December..	91	....	106	52	....	....	60	59

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 509. The Farm Mortgage Situation in Putnam, Union, and Greene Counties, Ohio, by V. R. Wertz. This study is primarily concerned with farm real estate mortgages and is intended to throw some light on the status of farm finance of interest to farmers, farm organizations, law makers, and others interested in improving the agricultural credit system.

Bulletin 510. Grafting and Budding Fruit Trees, by I. P. Lewis. This bulletin contains descriptions of the various methods of topworking and formulae for the waxes recommended for use.

Bulletin 511. Diseases of Ornamental Plants, by Paul E. Tilford. Specific diseases of ornamental plants are discussed and control measures are given.

Bulletin 512. Photoperiodism. The Value of Supplementary Illumination and Reduction of Light on Flowering Plants in the Greenhouse, by Alex Laurie and G. H. Poesch. Tests are reported on the feasibility for commercial greenhouses of increasing the length of day by artificial illumination and the decreasing of the day duration by shading.

Bulletin 513. Experiments with Growing Corn and Soybeans in Combination, by H. L. Borst and J. B. Park. Variety tests for the combination, rates of planting, and value of the combination are reported.

Bulletin 514. Land Utilization in Lawrence County, Ohio, by J. H. Sitterley, H. R. Moore, and J. I. Falconer. The purpose of this study has been to picture the different ways in which the less favorable agricultural areas of the State are being utilized.

Bulletin 515. The Chemical Composition and Nutritive Properties of Milk as Affected by the Level of Protein Feeding, by A. E. Perkins, W. E. Krauss, and C. C. Hayden. This bulletin reports studies on the chemical and nutritive properties of milk from cows fed different levels of protein.

Bulletin 516. Fifty-first Annual Report. In view of the fact that this Station has recently completed 50 years of service to the State and Nation, a brief résumé of its work is given. The experimental program involves some 3,400 acres of land, one-third of which is at Wooster, and the balance at 15 district and county experiment farms well distributed over the State and representing the principal soil types, as well as 58,000 acres of state forests and forest parks. Although less than one-half of the projects now under way are noted, the nature of the investigations being carried on is indicated and numerous practical results are given.

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WOOSTER, OHIO, U. S. A.

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Free Bulletin

C. G. Williams

Director

The new, triple-purpose pen battery especially designed for finishing broilers, for growing pullets, and for layers. See page 69

BATTERIES FOR CHICKENS

D. C. KENNARD AND V. D. CHAMBERLIN

Of the many great developments and discoveries of the past, none has excited such sudden, spontaneous interest among poultrymen as the possibilities of batteries. Needless to say, such an innovation is attended with serious liabilities. Hence, the purpose of this article is two-fold: (1) To emphasize the fact that batteries of all kinds are yet in their pioneering and experimental stage of development and that almost everything is yet to be learned about them; (2) to report actual experience and results as secured by this Station to date from the use of batteries.

The Wisconsin Experiment Station was the first to learn how to rear chickens successfully indoors by the use of cod-liver oil in the ration. This was in 1922. From this discovery has come a train of revolutionary developments, such as brooding chicks in confinement, confining the layers indoors, multiple-floor laying houses, and, finally, the batteries, battery brooders, and batteries for growing pullets and layers.

It seems that the present wave of interest and development in connection with laying batteries was initiated by the preliminary tests conducted with caged layers by the Ohio Experiment Station at Wooster in 1924 and the subsequent tests which have been in continuous progress since that date. The first test was with layers kept in wire cages 30 inches square, four birds to the cage. These tests were continued for 7 years and yielded some interesting results. One of the original layers lived until October 16, 1931, lacking 3 weeks of having spent 7 years in the cage. During this time she laid 544 eggs, 95 of which were laid during the seventh year. Of the 16 layers started in the first tests, only two died during the first 3 years. This becomes more significant when compared with the 15 to 30 per cent loss of similar pullets during the first year under the usual conditions of management. Eight inferior pullets laid 112 eggs per bird the first year, and a similar number of better quality pullets laid 144 eggs. The first 3 years' average total production for the inferior birds was 262 eggs per bird and that of the better grade layers was 335.

Tests with layers in individual cages 18 inches square were started in 1926 and continued for 3 years, with results comparable to the first tests with the birds in groups of four to the cage.

From these preliminary tests with a comparatively small number of birds, it was observed that hens kept in wire cages laid well and produced strong-shelled eggs with practically no loss from breakage, that the mortality of birds appeared to be less, that roosts or nests were not essential, that wire-screen floors did not make the hens' feet sore or affect them in any way even during a period of 7 years, and that the birds were apparently comfortable, happy, and contented.

In the meantime, progressive poultrymen became interested in the commercial possibilities of caging the layers, particularly in New Jersey, where there are now a number of installations of individual hen batteries with a

capacity of 1,000 or more layers. Obviously, no development of this kind could take place without the cooperation of manufacturers to provide suitable equipment; and they have already made great progress in their efforts to design such equipment.

COMMERCIAL BATTERIES FOR INDIVIDUAL LAYERS

Following the 8 years of preliminary tests with caged layers, the Station began tests on a more extensive scale to explore the commercial possibilities of batteries for layers. This phase of the work was necessarily delayed until suitable, commercial, individual laying batteries became available in 1931. The tabulated results of this work to March, 1933, are given in Tables 1 and 2.

DESCRIPTION OF TESTS

The pullets in the tests included in Table 1 were hatched in April and brooded on the floor in confinement until 12 weeks of age, when they were transferred to colony houses on summer range. Here they remained until the beginning of the tests as layers. All groups received the same ration, which was an all-mash ration in 1931-1932 and a whole grain-mash mixture the following year[1]. The birds received all-night light the first year and 4 A. M. light the second year. Each pullet was weighed monthly. The average weight per bird of the group was calculated for each month and the averages of the monthly averages are recorded in the first column; the final month's averages per bird are recorded in the second column.

The data presented in Table 1 are only suggestive of what may be expected in the way of performance and behavior of caged layers as compared to similar birds that are housed. However, until more data become available, these data are of significance in the consideration of a number of important questions which are arising in connection with laying batteries.

EGG PRODUCTION

The caged layers have led the housed layers in egg production in most of the tests. It would seem that laying batteries present no special problem insofar as the number of eggs is concerned. We have observed no difference in egg size or shell texture. The question of nutritive and market qualities of eggs produced by caged layers remains to be determined.

Egg eating and cracked, blind checked, and soiled eggs may be a serious problem or not, depending upon the type and design of the equipment. In one type of equipment 14 per cent of the eggs was cracked or blind checked, 66 per cent was soiled, and many eggs were lost from egg eating. In another type of equipment the cracked and blind checked eggs amounted to 3.3 per cent, 47 per cent was soiled, and egg eating was eliminated. Of the eggs gathered at the same time from the laying house, where plenty of nests filled with clean shavings were provided, 36 per cent of the eggs was soiled, and 7.5 per cent cracked and blind checked. Obviously, the problems of cracked and soiled eggs can be effectively solved in due time with improved equipment.

[1]Rations suggested for caged layers will be furnished upon request.

TABLE 1.—Production and Behavior of Caged Versus Housed Pullets

Kind of pullets	Year	Duration of test		No. of birds	Caged or housed	Eggs per bird*	Mortality	Feed per bird	Body weight	
		Date	Weeks						Average	Final
							Per cent	Lb.	Lb.	Lb.
Leghorns	1931-32	12/9–8/17	36	24	Caged	132	42	49.3	3.66	3.41
				50	Housed	118	52	49.9	3.48	3.57
White Plymouth Rocks	1932-33	9/29–3/1	18	21	Caged	76	33	31.0	5.68	5.99
				24	Caged	62	25	28.7	5.71	6.16
				50	Housed	63	18	31.7	5.29	5.77
Leghorn-White Rock cross-bred pullets	1931-32	12/9–8/17	36	24	Caged	131	37	47.6	4.35	4.28
				24	Caged	139	33	52.3	4.47	4.27
				40	Housed	123	50	48.4	4.92	4.79
				40	Housed	131	46	51.5	4.51	4.20
	1932-33	9/29–3/1	18	24	Caged	76	25	28.0	4.71	5.11
				50	Housed	70	32	28.7	4.38	4.59
				50	Housed	68	30	28.6	4.55	4.78

*Of birds completing test.

MORTALITY

The primary question in connection with laying batteries is whether caged layers will live as well as, or better than, housed layers. Other questions are of minor importance when compared with this. The mortality was high in all groups, due principally to leucosis, fowl typhoid, range paralysis, and the like—diseases of which the exact cause and mode of transmission are not well known. Nor do we know of an effective means of control or remedy. Practically all of the mortality of caged layers was preceded by a greenish-white diarrhea previous to death of the bird. This characteristic condition was readily observed with the birds in individual cages; whereas it was not when the birds were housed. However, by caging the afflicted birds from the laying house for observation the same condition of the droppings was observed. This suggested that the greenish-white diarrhea was characteristic of the housed layers as well as of those in cages.

The mortality data presented may slightly favor the caged layers, although the question of mortality is of such a nature that the differences can hardly be considered of much significance. This question will need to be answered with tests of longer duration with birds less subject to the causes of mortality experienced in these tests.

Nevertheless, the question of high mortality of birds in these tests does offer material food for thought in that we have generally assumed that most of our losses were in one way or another hooked up with faulty sanitation. It was hoped that the better sanitary conditions of the caged layers would prove a preventive of the diseases in question, but our experience thus far offers little encouragement for this belief. This was even true of the pullets which were started as day-old chicks in battery brooders, where they remained until 8 weeks of age when they were transferred to the laying batteries (Table 2). If we grant that this is about the last word in practical sanitation and yet it failed to reduce the losses from mortality materially, just how much relief from the diseases in question can be expected from that mode of attack?

Undoubtedly, sanitation in accordance with the popular meaning of the term has its place in the prevention of certain diseases; but evidence is becoming available to indicate that such measures as breeding, management, and feeding for birds of greater vigor, longevity, and for birds possessing greater resistance or immunity to the ravages of disease and internal parasites offer a greater promise for the final solution of the problem of excessive mortality. In other words, we seem to be becoming more reconciled to the fact that we are going to be obliged to live with and live down some of our most perplexing causes of mortality and that to succeed we must breed, manage, and adapt our stock so as to resist and survive the particular set of conditions prevalent on a given farm and locality. In an endeavor to apply this principle, recent tests at the Ohio Station indicate that one of the first steps to be taken by those who make it a practice of hatching chicks from pullet eggs is to abandon the practice and hatch eggs only from yearling or older hens. Of the pullets going into the laying houses in the fall the farm flock demonstration records of many states show that 50 to 60 per cent generally fail to complete their pullet year because of mortality and culls. Obviously, the hens are the better half of the pullet flock, and pullets should not be used as breeders until they have qualified as yearlings or older hens.

TABLE 2.—Batteries Versus Range for Growth of Pullets

Pullets reared	Duration of test		No. of birds	Management of layers	Eggs per bird†	Mortality	Feed per bird	Body weight	
	Date*	Weeks						Average	Final
						Per cent	*Lb.*	*Lb.*	*Lb.*
Test No. 1:									
In batteries	9/29—3/1	18	40	Housed	85	37.5	28.5	3.55	3.77
On range	9/29—3/1	18	50	Housed	71	22.0	30.3	3.53	3.75
Test No. 2:									
In batteries	7/7—3/1	34	60	Caged	80	43.3	43.4	3.74	4.06
On range	7/7—3/1	34	50	Housed‡	70	56.0	42.8	3.77	3.76
On range	7/7—3/1	34	50	Housed§	79	62.0	41.4	3.84	3.96

*1932-1933.
†Based upon living birds completing the test.
‡Confined indoors.
§Outdoor range.

Now we turn to a brighter side of the mortality problem. Many have long contended that colds, roup, and respiratory complications should be preventable by proper housing, feeding, and management. Our two years' experience with laying batteries substantiates this contention. We have yet to observe the first case among the caged layers of these troubles which have continued as usual with pullets in the laying houses, even where the housing conditions were made the best we could with artificial heat and ventilation. The caged layers had proper winter ventilation, not because of special ventilation but because the laying batteries occupied only about one-third of the room space. Or should this freedom of the caged layers from respiratory troubles be credited to the better sanitary conditions?

Also, practically no "bumble foot" has occurred among the caged layers. This, too, might be credited to better sanitation. Pigmentation of skin, beak, and shanks seemed much the same whether the layers were caged or housed.

FEED CONSUMPTION AND BODY WEIGHT

A careful comparison of feed consumption of caged layers with that of similar layers in laying houses reveals no significant difference despite the logical assumption that the caged layers might be expected to consume less feed. Likewise, one might reasonably assume that the battery layers would put on body weight, but the data show no significant difference in this respect.

GROWTH OF PULLETS IN BATTERIES

Many poultry raisers have succeeded with the growth of pullets confined to colony houses and wire-screen sun porches. Now the question arises, "Can we go a step farther and grow pullets in batteries?"

The pullets in Test 1 were April-hatched, brooded on the floor, and confined indoors until 12 weeks of age. Then one group of 288 pullets was transferred to metal fattening batteries. Each battery consisted of four decks of four 20 x 30-inch compartments. Three pullets were placed in each compartment where they remained from July 8 to September 29, when they were transferred to the laying house. The batteries were located in a comparatively dark basement room to prevent the vices of feather picking and cannibalism. In the meantime their sisters spent the summer in range shelters or in trees on a good fresh range with shade, green feed, and freedom to roam at will. They were placed in the laying house September 29.

The results given in Table 2 would seem to indicate that batteries have possibilities for the growth and development of pullets. In both tests the pullets grown in batteries were somewhat ahead in egg production; whereas the mortality of the battery-grown pullets was greater in the one test and less in the other. The growth of the pullets in batteries did not affect the body weight of the pullets as layers. Since these first attempts at growing pullets in batteries yielded encouraging results, the procedure offers a challenge for further exploration to determine its practical possibilities. Obviously, if pullets can be successfully grown and developed in batteries, the more cumbersome range methods would be relegated to the past by many poultry raisers.

In the second test of Table 2 the first group of 60 pullets was subjected to confinement in its extreme. In fact, these were factory-made pullets, never having been outside the building in which they were hatched and never having had their feet off the wire floors of batteries. They were hatched January 26,

1931, in the basement of the building and placed in battery brooders in an adjoining room until 8 weeks of age, when they were transferred to laying batteries located on the third floor of the building. Three of the 8-week-old pullets were placed in each 18 x 18-inch compartment of the laying batteries, where they remained until they started to lay. The pullets were given individual 12 x 17-inch compartments in a battery for layers on July 7. On the contrary, the two groups of their sisters were brooded on the floor, had the splendid summer range previously described, and were placed in a comfortable laying house where one group was confined indoors and the other had free access to a good outdoor range of Ladino clover and blue grass.

From the data, Table 2, it is obvious that no one of the groups has won thus far; all lost because of the management, condition, and inferiority of the pullets. The mortality of all groups was due principally to range paralysis, leucosis, and fowl typhoid. There have been few cases of range paralysis among the factory-grown caged pullets, as compared to the range-housed pullets. It is significant that the livability of the factory pullets has been better and that they appear to have been normal in every way, not excepting body weight. Whatever the causes of high mortality of all the groups, the mortality was not greatly affected by the radical differences of management. This again would seem to open wide the question of practical sanitation as a preventive of the causes of mortality as experienced in these tests.

The low egg production thus far has not been an altogether representative factor in the test. The factory birds began laying well at the start of the test and continued until a radical change of feed was made on August 22, with the result that but few eggs were laid during the 8 weeks to follow. While these pullets would no doubt have gone off production later regardless of the change of feed, the production during the 8 weeks in question would undoubtedly have been more had the change of feed not been made. With this exception these pullets have laid consistently to March 1. The range-housed groups did not get into as heavy production at any time, nor did they go out of production as did the battery pullets.

It is surprising that the battery-grown pullets held their own as well as they did in these two tests, especially when it is considered that it was our first experience in the attempt. Growing pullets in batteries is no exception to most new procedures in that we are obliged to learn how to succeed by study, experience, and adaptation.

THE TRIPLE-PURPOSE GROUP BATTERY

A new type of battery especially designed for finishing market broilers, growth of pullets, and for layers was recently designed by the Ohio Experiment Station. Each compartment accommodates 15 layers or 20 to 30 broilers or pullets, depending upon their size. Each unit, consisting of six compartments, can be placed against a wall or partition, or two units can be placed back to back. These batteries are equipped with wire floors, mechanical belt cleaning device, roosts, and nests. Where individual egg records are not the primary object this type of battery should appeal to poultrymen in general, since it will serve a triple purpose, is simple and economical of construction, and can be made by the poultryman who is handy with tools and mechanically inclined. Further details, working plans, and bill of material may be secured by a request addressed to the Ohio Experiment Station at Wooster.

MITES

Experience has taught that a new laying house, particularly the roosting quarters and nests, must be sprayed thoroughly with creosote wood preserver or its equivalent before using, as a preventive of red mite infestation. The same precaution is necessary for all-metal batteries. Two instances of heavy mite infestation of all-metal batteries have been experienced at the Ohio Experiment Station during the past year. In the one case, it was with pullets in fattening batteries, and the other was with individual laying batteries in another building. From first-hand experience we have learned that all-metal batteries are not proof against red mites, that new laying batteries should be thoroughly sprayed before using and yearly thereafter, or whenever one group of birds is being changed for another.

SUMMARY

Thus far we have experienced no serious obstacles or handicaps in connection with laying batteries, insofar as the performance and behavior of the birds are concerned, when compared to similar birds in laying houses. Battery equipment has recently been greatly improved and is due for continued improvements and refinements. The cost of production of improved equipment will become less as increased demand and quantity production take place.

Individual laying batteries offer unrealized advantages and opportunities for poultry breeders who are trapnesting, who desire to secure individual egg records, or who wish to prove prospective breeders as pullets in individual or pen batteries equipped with trap nests the first year to qualify them in all respect for breeders the following year. There are also opportunities for use of individual or pen batteries for laying contests.

While batteries did not seem to lessen the heavy mortality due to leucosis and fowl typhoid-like diseases, the number of cases of range or fowl paralysis among the caged layers which were grown as pullets in batteries was materially reduced, as compared to similar birds in the laying houses. No colds, roup, or respiratory troubles were experienced among the 600 caged layers during the past two years; whereas their sisters in the laying houses had their usual troubles of this kind.

It seems obvious that individual and pen or group batteries for layers will find their place as one of the standard methods of managing the layers, prospective breeders, egg laying contests, and for market egg production. Batteries for finishing market broilers after 6 weeks of age have become a standard practice, and now batteries for the growth and development of pullets have appeared upon the horizon. The battle of batteries is on—it is the new against the old. Which will finally prevail?

A COMPARISON OF THE WET AND THE DRY METHODS OF INOCULATING LEGUME SEED

H. W. BATCHELOR AND I. H. CURIE[1]

Commercial legume inoculation cultures, recommended by the manufacturers to be used in a dry form on dry seed, have been sold in Ohio for several years. In tests conducted by the Station, these new cultures have proved to be either not uniform in quality or inferior to the older types of cultures that are recommended to be applied wet.

The question arises as to whether the new cultures are actually inferior or whether the primary cause of their apparently inferior quality may be the result of the dry method of inoculating the seed. The following study was conducted to answer this question.

PROCEDURE

Samples of each brand of commercial inoculation culture sold in Ohio were bought on the open market and tested in the field and in the greenhouse. The tests reported in this paper were limited to sand, soil, humus, and carbon cultures, since jelly cultures can not be applied to the seed in a dry form. In tests conducted by the Station, the jelly cultures have given satisfactory inoculation.

FIELD TESTS

In the field tests, an attempt was made to conduct the work under conditions comparable to those the farmer would have to meet. A composite culture was prepared from all the samples of a given brand. Using the concentrations recommended by the manufacturer, one portion was applied to the seed—Manchu soybeans—with the addition of water; another was used in dry form on dry seed. The seed was sown immediately after inoculation to prevent injury by excessive drying. Each lot of inoculated seed was sown across four strips of land adjusted to the following soil reactions: pH 4.5, pH 5.0, pH 5.5, and pH 6.0. The individual plot for a single reaction consisted of four rows, 7 inches apart and 37 feet long.

When the beans had reached a stage of growth designated as "seed pods well formed and seed beginning to develop", four 10-plant samples were dug up for each treatment and the percentage of plants with nodules was determined. Also, the nodules were removed from these plants, washed, dried at 105° C. for 24 hours, and weighed.

GREENHOUSE TESTS

In the greenhouse, two series of tests were conducted on individual samples of each brand. In the first series, as in the field tests, the cultures were tested in concentrations recommended by the manufacturers by both the "wet" and the "dry" methods. The method used to grow the plants was necessarily different from the field work. Sterilized seed was inoculated with the cultures and immediately planted in sterilized pure silica sand in glass

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[1]The junior author has done the field and laboratory work in these studies.

tumblers. When necessary, the plants were watered with a sterile nutrient solution. After 3 weeks, the plants were washed cut and the number of plants with nodules was determined. In the second series of greenhouse tests, the number of effective nodule-forming bacteria in each individual sample was counted by a somewhat similar technique.

RESULTS

A list of the number of samples of each brand of culture tested, together with their moisture contents and the weight of culture per bushel of seed, is given in Table 1.

TABLE 1.—Commercial Soybean Cultures Tested in 1932

Culture	Number of samples tested	Moisture content	Weight of culture per bushel of seed
		Per cent	*Grams*
A	3	43.3	66
B	1	17.1	383
C	4	8.0	79
D	3	8.9	111
E	2	13.3	110
F	1	5.0	64

Cultures A, B, and E are recommended by the manufacturers to be applied to the seed in a wet form and are considered as the older types of "wet" culture. The other cultures are recommended by the manufacturers to be used in a dry form on dry seed and are considered as the newer types of "dry" culture. Cultures A and B have always produced satisfactory inoculation in the tests conducted by the Station. Culture E, although a "wet" type culture, has not given satisfactory inoculation in the tests conducted by the Station and, in the tests here reported, did not give results comparable with the other two "wet" cultures.

TABLE 2.—Results of Field Tests

	Plants with nodules				Weight of dry nodules per 100 plants			
Soil reaction ☞	pH 4.5	pH 5.0	pH 5.5	pH 6.0	pH 4.5	pH 5.0	pH 5.5	pH 6.0
Culture	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Uninoculated Check	5	13	40	48	0.1	0.1	1.8	0.9
A Wet	68	88	95	93	2.0	4.0	5.6	6.4
Dry	43	60	75	80	0.4	2.4	2.3	2.0
D Wet	15	78	73	63	0.1	2.5	3.8	1.2
Dry	3	10	23	38	0.1	0.1	0.6	0.5
Uninoculated Check	8	5	13	20	0.3	0.1	0.2	0.3
F Wet	10	33	25	25	0.1	0.9	0.4	0.7
Dry	3	8	8	23	0.1	0.1	0.2	0.7
C Wet	10	53	73	73	0.1	2.5	3.1	3.1
Dry	3	10	25	25	0.1	0.1	0.6	1.7
B Wet	80	100	98	98	3.7	5.6	7.5	9.8
Dry	35	33	45	65	1.2	0.5	2.1	3.3
E Wet	15	40	40	60	0.3	0.6	1.0	2.4
Dry	30	23	40	63	0.6	0.3	0.8	2.5
Uninoculated Check	43	23	38	70	1.5	0.5	1.3	2.5

The results of the field tests on the composite cultures are given in Table 2. The results of the greenhouse tests on the individual samples have been averaged and are given in Table 3.

TABLE 3.—Results of Greenhouse Tests

Culture	Series 1 Plants with nodules		Series 2 Nodule-forming bacteria per pound of seed
	Wet	Dry	
	Pct.	*Pct.*	
A	88	91	1,900,000*
D	9	0†	27,000†
F	7	0	27,000
C	9	8	75,000
B	92	54	2,700,000*
E	0	0	None found
Uninoculated Check	0	0	None found

*The actual counts on these samples may have exceeded these figures since the method used did not permit making a count in excess of those here given.

†Two of three samples contained no organisms. The results given are for one sample only.

DISCUSSION

Two situations are evident in the data presented in Table 2. The satisfactory brands of the "wet" types of culture, Cultures A and B, have given distinctly more inoculated plants and larger yields of nodules than the newer "dry" cultures. This is especially noticeable in the tests in which the cultures were applied in a wet form. Moreover, the application of all the cultures in a wet form has resulted in a larger percentage of plants with nodules than the application of the cultures in a dry form. Culture E is an exception. On plot pH 4.5, in this case, the inoculated seed resulted in fewer plants with nodules than the uninoculated checks, and on plot pH 5.5, although there was no difference between the "wet" and the "dry" applications, neither of these gave appreciably better results than the uninoculated checks. The results on the weights of nodules produced by the different cultures and the different methods of applying them, although less striking, are nevertheless conclusive. Of 24 tests, 18 gave larger yields of nodules when applied "wet" than when applied "dry'. Of the remaining six tests, four gave the same weight of nodules when applied "wet" and "dry", but each of these six tests gave yields of nodules which did not vary significantly from the uninoculated checks. Here again, the older types of "wet" cultures gave better inoculation than the newer types of "dry" cultures.

The results obtained in the greenhouse tests, given in Table 3, confirm the findings obtained in the field. Contaminations that may occur in the field are avoided in the carefully controlled greenhouse tests. For this reason greenhouse tests may be more clear-cut than field tests. A close relation is evident between the quality of the cultures as determined in Series 1 and in Series 2. In each series the older types of "wet" cultures were superior to the newer types of "dry" cultures. Furthermore, the "wet" application of cultures again produced better results than the "dry" application. Culture A is an exception since, in a dry form, it gave 3 per cent more plants with nodules than when it was used in a wet form. This difference probably is not significant.

Since comparatively ideal conditions for nodule formation prevail in the greenhouse, the differences in inoculation obtained by the "wet" and the "dry" applications would not be considered conclusive by themselves. However, they confirm the findings in the field and, therefore, are considered significant.

CONCLUSIONS

Tests conducted on commercial soybean inoculation cultures, purchased on the open market in 1932, have indicated:

1. That the newer types of "dry" cultures are inferior to the older types of "wet" cultures in the number of nodule-forming bacteria supplied per pound of seed, in the ability of the cultures to inoculate as many plants, and in their ability to produce as large yields of nodules.

2. That the "dry" method of applying the inoculation is distinctly inferior to the "wet" method.

Note. These findings on soybeans have been confirmed, in general, in other studies on cultures for alfalfa and sweet clover. The farmer is urged to inoculate sweet clover and alfalfa unless well inoculated crops have been grown on the field to be sown to either of these crops. This applies especially to acid or recently limed soils in the eastern half of the State. Soybeans should be inoculated unless well inoculated soybeans have been grown on the field to be sown. The farmer is warned not to purchase inoculation cultures that are intended to inoculate non-leguminous crops such as wheat, oats, or barley. A new inoculation culture has recently appeared on the market that is not only supposed to inoculate the non-leguminous crops but is also supposed to be a substitute for potash and phosphate fertilizers and to take the place of lime. Buying such cultures is an excellent way to waste money.

A circular which discusses the inoculation of legumes and gives a list of the approved commercial inoculation cultures will be sent on request.

CULTIVATION OF CORN

H. L. BORST AND G. M. McCLURE

Experiments on the cultivation of corn have been conducted for 7 years at Columbus. Many experiments have indicated that weed control is the chief purpose of cultivation and that yields of corn are not increased by more cultivation than is necessary to control weeds. This conclusion has not been borne out by farm experience under all conditions. The aim of the work at Columbus has been to ascertain, if possible, whether weed control is the chief purpose of cultivation and, if it is not, what the other functions of cultivation are.

PLAN OF EXPERIMENTS AT COLUMBUS

The various treatments have been.

1. Weeds removed from the soil by scraping with a hoe, so as to disturb the soil as little as possible.
2. Cultivation of average depth (2"-3"), sufficient to control weeds, usually three times. This was supplemented by hoeing if needed.
3. More cultivation than enough to control weeds, usually four times.

The plots have consisted of five rows, 3 or 3½ feet apart, varying in length in different years from 75 to 110 feet, planted usually in three replications. Only the center three rows have been harvested for yield. Nearly perfect stands have been obtained by planting thick and thinning.

The scraping treatment was included not as an example of farm practice but to eliminate weeds without disturbing the soil in order to answer the question—"Does cultivation while, or in addition to, destroying weeds benefit the corn crop in some way other than by destroying weeds?"

In Treatment 3 (cultivated beyond weed control) a definite effort has been made to keep the soil surface broken but not in a dusty condition. Usually four cultivations have been enough to do this; in some years five cultivations were made.

The experiment was begun in 1926 on a Miami silty clay loam soil and, since 1927, has been duplicated on the Brookston silty clay loam. The former is a light-colored soil inclined to pack or bake during the growing season; whereas the Brookston is a fairly deep, dark, loose soil high in organic matter. Both types are common in west central Ohio.

The yields of shelled corn and fodder are given in Table 1.

Weed control the chief purpose of cultivation on Brookston soil.—On the Brookston (dark-colored) soil no cultivation treatment, in any year, has given a yield of shelled corn significantly greater than that obtained on the plots where the weeds were removed by scraping with a hoe and the soil was disturbed as little as possible.

Cultivation has value in addition to weed control on Miami soil.—On the Miami (light-colored) soil the plots on which weeds were controlled by cultivation have produced, as a 6-year average, over 3 bushels of shelled corn per acre more than the plots where weeds were controlled by scraping. As a 7-year average the gain for cultivation was more than 4 bushels per acre.

TABLE 1.—Cultivation of Corn at Columbus

Plot and treatment	Miami silty clay loam									Brookston silty clay loam						
	1926	1927	1928	1929	1930	1931	1932	6-yr. Av.	7-yr. Av.	1927	1928	1929	1930	1931	1932	6-yr. Av.
Acre yields of shelled corn (15% moisture)																
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
1. Weeds eradicated by scraping with hoe	35.0	48.0	64.7	61.4	16.6	79.5	67.8	56.3	53.4	67.4	72.7	65.0	42.1	81.3	104.6	72.3
2. Cultivated enough to control weeds	45.3	59.1	66.8	60.1	16.0	86.4	69.7	59.7	57.6	66.2	67.7	63.0	40.2	76.9	105.1	69.8
3. Cultivated more than No. 2	....	65.4	66.4	64.5	18.7	85.7	74.3	62.5	....	67.2	73.6	60.9	44.3	78.5	105.1	71.6
Acre yields of fodder—Air-dry weights																
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1. Weeds eradicated by scraping with hoe	5170	4980	10630	6710	2630	7410	8640	6830	6595	6570	10030	6640	6270	9160	11340	8340
2. Cultivated enough to control weeds	6610	6170	11100	7040	2980	8240	8300	7300	7200	7020	10210	6590	6390	9100	11470	8440
3. Cultivated more than No. 2	....	7200	11170	7440	3020	8240	9110	7700	....	7040	10510	6290	6620	8880	11610	8490

One or more cultivations in addition to those needed merely for weed control resulted in an increased yield of nearly 3 bushels per acre as a 6-year average. The yields of fodder show similar increases from cultivation on the Miami soil.

An effort has been made to ascertain by sampling and analysis whether or not the increase in corn yields on the Miami soil has been caused by the conservation of soil moisture or the liberation of nitrates. There has been no indication of a higher nitrate content in the cultivated plots than in the scraped plots on either soil; there has been evidence of a higher moisture content in the cultivated plots, especially on the Miami soil.

As a 5-year average (two or three sampling dates each season) the cultivated plots on the Miami soil have contained 16.1 per cent moisture and the scraped plots 14.7 per cent. Estimated from its moisture equivalent, this soil would contain at the wilting point about 13.7 per cent moisture. For the Brookston soil the corresponding percentages are: cultivated, 19.4; scraped, 18.7; wilting point, about 16.3. Although the absolute differences in moisture content for the two methods of cultivation appear small, the actual difference in the amounts of water available to the crop may have been considerable.

CONCLUSIONS

It is clear that there is a distinct difference in the response of these two soils to stirring or the maintenance of a mulch. Translated to farm practice, the results indicate: (1) That, on Miami silty clay loams (and probably on similar soils) which pack, bake, or become crusted, cultivation has a beneficial action in addition to controlling weeds and that cultivation to maintain a broken condition of the soil surface may result in increased yields of corn; (2) that, on the Brookston silty clay loams (and probably similar soils), loose, "self-mulching" soils, well supplied with organic matter, the chief purpose of cultivation is weed control and that stirring the soil will not in itself increase the yield of corn.

VITAMIN-D MILK

W. E. KRAUSS AND R. M. BETHKE

The function of vitamin D is to assist in the assimilation of calcium and phosphorus, the two elements so vital in proper skeletal development. Practically all natural foods are either devoid of or contain very little vitamin D. Certain marine products, and eggs produced under proper conditions of feeding and management, are fair to good sources of this factor. The amounts of these foods commonly consumed, particularly by children, are not sufficiently great to meet the needs of the body for vitamin D. It has been necessary in the past, therefore, to depend upon special vitamin preparations or ultra-violet light from the sun or from artificial sources to obtain an adequate amount of this factor. The need for vitamin D is greatest in children, but, in view of recent work which has demonstrated a relationship between vitamin D and dental caries, the role of this factor in the nutrition of adults as well as children assumes new significance.

In spite of the availability of many good, reliable sources of vitamin D, rickets and dental caries resulting from malnutrition are still too prevalent. In view of this, steps have been taken by numerous investigators to increase the vitamin-D content of common articles of food like milk and bread to the extent that, when taken in the usual quantities, these foods will supply sufficient vitamin D to meet the body's needs.

The successful development of several methods for increasing the vitamin-D content of milk has created much interest among dairymen and has raised many questions as to which method is best suited to a particular situation. The purpose of this article is to discuss impartially the methods now in operation in the hope that those interested in the production of vitamin-D milk may have an unprejudiced basis on which to make a decision.

METHODS OF PRODUCING VITAMIN-D MILK

There are at the present time three methods for producing vitamin-D milk: (1) By feeding irradiated yeast to cows; (2) by adding a cod-liver oil concentrate (Vitex) directly to milk; (3) by irradiating milk (that is, subjecting it to ultra-violet light rays). The first method has been in use for the longest time and consequently its use is spread over a larger area than is either of the other two methods. Use of the second method is steadily increasing; whereas irradiated liquid milk is just beginning to appear on the market. (White Swan Farm, Fairview, Pa., has been producing irradiated milk for several years).

Irradiated yeast.—The production of vitamin-D milk by this method is accomplished by feeding cows irradiated yeast. The amount of yeast fed daily is based on the production of the cows. The yeast may be fed to each cow separately or it may be included in the regular grain mixture. Milk from cows fed the proper amount of irradiated yeast will contain about 160 Steenbock rat units of vitamin D per quart of 4 per cent milk. Such milk has been fed to children and has been found to be effective in preventing or curing rickets.

The chief advantage of this system of producing vitamin-D milk lies in the fact that when the milk leaves the cow it contains the required amount of vitamin D and no further "tampering" is needed. The resulting product in this case may be termed "milk naturally rich in vitamin D".

The production of vitamin-D milk by this method is naturally limited to individual herds and, consequently, the number of individuals to be benefited will be limited accordingly. This method is, therefore, of particular advantage to the producer of milk for retail trade.

One disadvantage of this method is that there is no assurance that the yeast will be fed faithfully from day to day. A checking-up system developed by the company supplying the yeast serves to reduce this objection to a minimum.

The chief disadvantage of this method lies in its inefficiency. Only a small percentage of the total number of rat units of vitamin D fed to the cows is recovered in the milk. Nevertheless, it is possible to produce milk by this method at an increased cost of only about one-half cent a quart. This cost probably can be further reduced.

The irradiated yeast must be bought from Standard Brands Incorporated, 595 Madison Avenue, New York City, and a small license fee must be paid to the Wisconsin Alumni Research Foundation.

Addition of Vitex.—In this method the procedure consists simply of adding a prescribed amount of Vitex to milk, the amount added varying, of course, with the size of the batch. The resulting product contains 150 Steenbock rat units of vitamin D per quart.

The greatest advantage of this system lies in its efficiency. There is no waste, and a large amount of milk can be treated at one time in the milk plant.

One disadvantage is that there is no assurance that the correct amount of supplement has been added to the milk. This offers no particular danger. Too little supplement over a period of a day or two would not affect materially those depending upon the milk as a source of vitamin D; too large an addition of supplement would probably be noticeable in the taste, but even if the milk were allowed to be consumed no damage would be done as massive doses of vitamin D are required to produce any toxic effects.

Another disadvantage of this method is psychological. The fact that something has been added to the milk after it was produced does not lend itself well to sales appeal.

The addition of Vitex to milk increases the cost approximately one-half cent per quart. In order to use this process arrangements must be made with the National Oil Products Co., Harrison, N. J., who manufacture and distribute Vitex under Columbia University Patents.

Irradiation.—It is now possible to impart a potency of 50 Steenbock rat units per quart to milk by irradiation, without affecting the taste or destroying any of the nutritive properties of the milk. This is accomplished by exposing for a few seconds a very thin film of milk to the rays from flaming carbon arc lamps. Milk so treated has been shown clinically to be effective in the treatment of rickets. Specially built apparatus is employed, the nature of the setup being varied according to the needs of the particular situation.

The outstanding advantage of this method lies in the ultimate low cost per quart of milk. Definite information on the cost is not available. In connection with experimental work in which carbon arc irradiation was used, one worker reported a cost of 1/25 of a cent per quart of milk. This estimate probably did not include such items as royalty, interest, depreciation, etc. However, at the present time, irradiation probably affords the cheapest method for producing vitamin-D milk on a large scale.

The method has the further advantage of eliminating to a greater extent the human element of error that enters into the other two methods. The amount of radiant energy imparted to the milk can be accurately recorded by means of ultra-violet ray meters which may be used in much the same capacity as recording thermometers are used in pasteurization.

The cost of the apparatus required is quite high, and, for a time at least, installations will of necessity be restricted to large milk plants having a sufficient volume of business to offset the initial cost soon.

The great disadvantage of this method involves again the psychological reaction created in the minds of consumers.

As far as is now known the Borden Company and the Creamery Package Manufacturing Company have both developed apparatus for commercial milk irradiation. A license to irradiate milk must be obtained from the Wisconsin Alumni Research Foundation.

GENERAL CONSIDERATIONS

Assuming that the principle of vitamin-D milk is sound and that satisfactory methods for producing such milk are now available, there remains the problem of control. What assurance does the consumer have that the milk purchased as vitamin-D milk contains the specified amount of vitamin D? To determine the amount of this factor in a given sample of milk is a laborious and time-consuming procedure. A given plant could hardly afford to have its milk assayed for vitamin D more than once a month and small producers would find even this an expensive procedure. Unfortunately, no reliable chemical methods are yet available for determining the amount of vitamin D in foods. Assurance that the milk will measure up from day to day to the standards set must rest largely on confidence in those responsible for vitamin-D milk production. Careful selection of licensees, reasonable supervision, and frequent assays should also be expected.

PROTEIN USED BY PRE-SCHOOL CHILDREN. I.

HUGHINA McKAY AND EVANGELINE KLEPINGER EVANS

The amount of protein in children's diets should be sufficient to provide for growth, as well as for replacement of protein lost through the "wear and tear" constantly going on in the organism. During the entire period of childhood the amount and quality of the protein used are of importance, but just what the most desirable amount is has not been determined. Much interest is therefore attached to information concerning the amount of protein which healthy, normal children eat, although such amounts cannot be taken as absolute indications of the amounts needed.

A review of the literature shows that there are comparatively few studies which give accurate accounts of the protein intake of individual pre-school children. Among the early reports of the dietary needs of children is the summary by Gillett of all the studies on food consumption made prior to 1917. The data assembled were from three sources; namely, dietary studies, metabolism studies, and respiration experiments. Gillett found the average daily protein intake for 37 children between 2 and 5 years of age to be 53 total grams, or 3.3 grams per kilogram of body weight. The author reports that all of the children observed were growing normally, although some of the children were underweight.

A study by Holt and Fales in 1921 included 106 healthy children from one to 16 years. The children were living in private homes and were of intelligent parentage. A record was obtained of the exact amount of food taken by each child for 4 days. The food value was determined from Locke's Manual. These figures for cooked foods introduce a source of error as recognized by the authors. The net result, however, "is approximately accurate". The findings of this study show that the children between the ages of one and 6 used 3.15 to 3.80 grams of protein per kilogram, daily. Approximately two-thirds of the protein intake was from animal sources. Fifteen per cent of the total calories was furnished by protein. Although some error is to be attributed to the method used, the results present a valuable indication of the protein consumption of individual healthy children.

In 1924, Goodhue made a dietary study of 31 healthy children from 2 to 6 years of age. The food consumption for the first day was determined by the individual method; whereas for the remainder of the 7 days a record of the child's food intake was kept by the mother. The average total protein intake for the group was 57.8 grams, or 3.0 grams per kilogram per day. Protein furnished an average of 14.2 per cent of the total calories. Possibility of error due to the method used is to be recognized, but the results are of interest for comparison with other studies made by the individual method.

In 1926, McKay reported a 4-day dietary study made by the individual method on 55 normal children from 2 to 4 years of age. Twenty-five of the children lived in private homes, and 30 were residents of an orphanage. Data given for the private-home children show that the average daily protein intake was 53 grams for boys, as compared to 45 grams for girls. The per kilogram consumption was 3.07 grams for boys and 2.83 grams for girls. For the entire group of children, orphanage as well as private-home, 12 per cent of the total calories was supplied by protein.

A dietary study was made by Blair in 1929 on 15 superior pre-school children in their own homes for one week. Eleven children were from 18 months to 6 years old; four were from 6 to 8 years old. An aliquot portion consisting of a composite sample of the food eaten for the week was analyzed for protein. The oxycalorimeter was used to determine the calorie value of the food. The findings show that the children under 6 years received a total average of 52.2 grams of protein per day, or 3.07 grams per kilogram.

Waite presents a summary of data from all the studies which have ever been made as far as she was able to obtain them, including those made by foreign investigators. An average of the intake of 73 girls from 2 to 6 years, either designated only as healthy, normal children or shown to be of average weight or slightly above and not obese, shows 48.6 grams of protein, or 2.77 grams per kilogram, to be used daily. Although this summary included only girls, it is valuable for comparison with the protein intake of other pre-school girls.

A comparative dietary study of the food consumption for one week of 50 Negro, 50 white American, and 75 Mexican pre-school children was reported by Winters in 1931. Only the record of the protein received by the white American children will be considered here. The findings show an average daily protein intake per kilogram of 2.63 grams for the boys, as compared with 2.36 grams for the girls. Although this study was made by the survey method, the results are of interest because of the large number of children studied.

Rose and her co-workers reported in 1932 a dietary study, for a 4- or 5-day period, made near the beginning of each term for 4 years at the Nursery School of the Child Development Institute at Columbia University. The procedure is described as follows:

> "Blanks were furnished for records at home and at school. Records of food eaten at home were kept by the mothers after careful discussion of the precautions to be observed to insure accuracy. . . . . As the children came from American homes, superior intellectually and economically, and as the parents were as a rule most cooperative and painstaking, it is felt that their records have a high degree of reliability. In any case where there was any doubt of such cooperation the record has been excluded from the survey of the dietaries for the four year period."

The 163 children were divided into two groups, the 2- and the 3-year-olds. The median for the total protein intake per day was 46 grams, or 3.52 grams per kilogram, for the 2-year-olds and 50 grams, or 3.30 grams per kilogram, for the 3-year-olds.

In addition to these dietary studies, a series of protein metabolism studies has been made by different investigators on both normal and underweight children. In 1930, Parsons made a study of the nitrogen metabolism of five normal children 4 to 8 years old in order to determine if it was possible to maintain a positive nitrogen balance on less than 2.2 grams of protein per kilogram per day. An infection, not attributed to diet, occurred in one child soon after the beginning of the experiment. For the remainder, the method was as follows:

> "The mother was given the diet list and a scale weighing in grams. She was taught how to weigh the diets called for and was supervised until I was sure that her figures could be relied on."

The food intake was calculated, and nitrogen determinations were made daily on the urine and the feces. Evidence is presented to show that a healthy child 4 to 8 years old could maintain a nitrogen balance and make normal development on a daily per kilogram intake of 1.1 grams, two-thirds of which was animal protein. The author did not state whether or not he considered this amount as optimum. The results would seem to indicate, however, that it is possible to feed a low-protein diet to normal children without apparent harm.

A study of protein metabolism in underweight, as compared to normal, children was made by Wang, Hawks, and Hays in 1928. A series of 59 experiments was conducted on 10 normal and 39 underweight children. All of the subjects were brought to the hospital for the experimental period. Although it was originally planned to keep the children on the same level of nitrogen intake, the amount varied from 2.48 to 4.29 grams due to differences in appetite. The results show that the average absorption of nitrogen was approximately the same for both normal and underweight children, varying from 90.1 to 91.9 per cent of the intake. There was a marked increase in retention, however, in the undernourished children over the normal. The retention increased with the degree of underweight, being 9.3 per cent for the normal and 17.2, 20.3, 22.1, and 24.3 per cent for the successive stages of underweight. The normal children retained an average of 0.26 grams of protein per kilogram as compared to 0.84 grams for the undernourished group. The authors state:

> "The fact that the nitrogen retention increases with the degree of underweight, indicates that as the child gains in weight he is building muscular tissue as well as storing fat."

It was suggested that the protein requirement of undernourished children be computed on the basis of the standard, rather than the actual, weight of the child.

In a later study in 1928, Wang, Hawks, and Kaucher attempted to determine whether any relationship existed between protein intake, nitrogen storage, and rate of growth. Two series of experiments, using a high-protein diet in one and a low-protein diet in the other, were performed with eight normal and nine undernourished children, 4 to 12 years of age. The findings

show that with a nitrogen intake of 2.7 to 4.3 grams per kilogram on the high-protein diets, the percentage retention of nitrogen was about the same for both normal and undernourished children. On a low-protein diet of 1.25 to 2.50 grams per kilogram, the percentage retention was higher for the undernourished children than for the normal, with the retention increasing with the degree of underweight. The authors state:

> "The nitrogen storage per kilogram of body weight was twice as high for the groups of undernourished children on the high protein as on the low protein diet, the nitrogen intake also being about twice as high on the former diet."

A remarkable gain of weight followed an increase of protein in the diet, even in the normal children. Four grams of protein per kilogram per day are suggested by the authors for undernourished children. These two studies by Wang and her associates indicate that not only the degree of underweight but also the amount of protein used are factors in determining nitrogen retention and growth.

The possibility of using a low-protein diet for diabetic children has also been investigated. In a study by Boyd in 1925 on the nitrogen metabolism of 12 diabetic children, an attempt was made to determine the minimum amount of protein required for nitrogen equilibrium and a positive nitrogen balance. She states:

> "The lowest intake at any age at which nitrogen equilibrium occurred was 1.25 grams of protein per kilogram of body weight in a boy, aged 13, barely 10 per cent below weight, and receiving sufficient calories. Children more than 10 per cent underweight required relatively more protein."

As this figure was the minimum and no allowance was made for growth and repair, Boyd concludes that the protein requirement is best determined by allowing 2 to 3 grams of protein per kilogram of expected weight, depending on the age of the child.

In 1926, Bartlett continued the investigation of nitrogen metabolism in diabetic children with the object of determining the actual minimum protein requirement. This he defines as "that amount of protein which will establish a positive nitrogen balance, prove adequate for growth, stature, promote normal development, and allow the child to gain weight at a normal rate". Balance experiments were performed on a group of six diabetic children from 4 to 14 years old for 6 months. He concluded that:

> "Children between the ages of four and fourteen years maintain a positive nitrogen balance, growth in stature, gain weight at a normal rate and develop normally when supplied with 0.6 to 1.0 gram of protein per kilogram of body weight provided (a) the calorie requirement is fulfilled, and (b) the diet is adequately chosen from foods rich in vitamins."

It would appear from the findings of Boyd and Bartlett that it is feasible to feed diets low in protein to diabetic children if all other dietary requirements are adequately provided.

PROTEIN USED BY PRE-SCHOOL CHILDREN. II.

HUGHINA McKAY AND EVANGELINE KLEPINGER EVANS

As a small part of a more intensive investigation into the food habits and physical development of normal, healthy, pre-school children, a study was made of the protein used by them. The food intake of eight children was determined for one week during January 1932, and for seven of the same children during March of the same year.

All the children in the group were examined by the same pediatrician in both seasons and were all described as being normal, healthy, and in good nutritional condition. The children ranged in age from 19 months to 3 years at the beginning of the study. All were living in private homes and the cooperation of the parents made the securing of accurate results possible. Data were collected by young women who went into the homes at meal time and weighed all the food eaten by each child for a week. When the children were in the nursery school for the noon meal, the food intake was determined there in a similar manner. From the data collected, the total calories, protein, fat, carbohydrate, calcium, phosphorus, and iron used by each child for each day of the study of each season was calculated.

Table 1 shows the average daily protein intake for individual children, as well as the average for the entire group during one week in January and also for one week during March.

As shown by this table the average total daily protein intake increased from 38.7 grams during January to 41.2 grams during March. During both seasons the protein intake of the boys exceeded that of the girls. During both seasons, also, a higher total protein intake was accompanied by a greater height and weight in the children.

The protein intake is frequently compared on the basis of body weight as well as of body height. For the children of this study the average amounts used per kilogram, as well as per inch, varied little among the children and averaged 2.76 grams per kilogram and 1.09 grams per inch daily during January as compared to 2.84 grams per kilogram and 1.14 grams per inch during March.

Although the average daily protein intake for the week's time varied little among the children, a wide variation was found in the amount of protein individual children used from day to day. For example, in January the child whose protein intake varied least had a minimum intake of 23.0 grams per day as compared to a minimum intake of 35.2 grams, a difference of 12.2 grams. For the child whose intake varied the most the corresponding figures were 30.2 and 52.3 grams, a difference of 22.1 grams. These variations were found to be slightly higher than those found by McKay in 1926, who reported that only 17 of the 55 children whose diets were studied varied the amount of protein eaten by as much as 10 grams. The variation shown in the present study tends to show that a child's food intake must be determined for a sufficiently long period of time in order to obtain a reliable average.

The quality as well as the quantity of protein is of considerable importance in the diet of the growing child. Protein most efficient in supporting growth should be used in generous amounts. For this reason the sources of the protein used by the children in this study are of interest. Table 2 shows the percentage of protein derived from each of the food groups for January and March. Figure 1 presents this material in a comparative form.

TABLE 1.—Average Daily Protein Intake of Individual Children

Child	Age	Weight	Height	Total grams	Grams per kg.	Grams per in.
January						
Boys No.:	Yr. Mo.	Kg.	In.			
1	1 7	13.29	33.50	43.8	3.30	1.31
2	1 7	13.78	32.75	40.8	2.96	1.24
6	2 5	16.56	38.25	41.0	2.48	1.07
7	2 11	14.91	38.12	41.0	2.75	1.07
Average	....	....	....	41.6	2.87	1.17
Girls No.:						
3	1 8	12.79	32.62	30.4	2.38	0.93
4	2 0	12.02	34.50	31.3	2.61	0.91
5	2 2	15.93	36.12	39.9	2.50	1.10
8	3 4	13.46	37.12	41.5	3.08	1.12
Average	....	....	....	35.8	2.64	1.02
Av. for the entire group in January	....	....	....	38.7	2.76	1.09
March						
Boys No.:						
2	1 9	14.29	33.62	39.7	2.78	1.18
6	2 7	16.81	38.62	42.0	2.50	1.09
7	3 1	15.02	38.75	45.9	3.06	1.19
Average	....	....	....	42.6	2.78	1.15
Girls No.:						
3	1 10	13.07	33.50	37.8	2.89	1.13
4	2 2	12.50	34.50	32.4	2.59	0.94
5	2 4	16.50	36.25	49.3	2.99	1.36
8	3 6	13.49	37.38	41.1	3.05	1.10
Average	....	....	....	40.2	2.88	1.13
Av. for the entire group in March	....	....	....	41.2	2.84	1.14

TABLE 2.—Sources of Protein in the Diets of Individual Children

Child	Av. protein Gm. daily	Milk Per cent	Cereal Per cent	Vegetables Per cent	Fruit Per cent	Meat and egg Per cent	Fatty foods Per cent
January							
Boys No.:							
1	43.8	54.2	20.6	6.3	1.0	17.7	0.2
2	40.8	42.2	29.0	4.4	2.1	22.2	0.1
6	41.0	53.3	16.4	6.6	2.7	20.0	1.0
7	41.0	62.2	11.8	6.1	3.7	15.6	0.6
Girls No.:							
3	30.4	37.2	29.9	9.9	0.2	21.9	0.9
4	31.3	65.6	24.6	3.1	1.4	4.7	0.6
5	39.9	48.0	11.4	10.8	4.2	24.9	0.7
8	41.5	40.3	26.0	7.1	3.5	22.4	0.7
Average	38.7	50.4	21.2	6.8	2.4	18.7	0.6
March							
Boys No.:							
2	39.7	52.3	20.6	4.3	2.5	20.0	0.3
6	42.0	55.8	13.6	6.4	3.0	20.8	0.4
7	45.9	57.3	12.4	5.7	2.4	21.6	0.6
Girls No.:							
3	37.8	37.9	18.6	11.1	0.4	30.6	1.4
4	32.4	63.4	21.7	7.1	3.1	4.6	0.1
5	49.3	56.7	16.2	5.4	3.1	18.1	0.5
8	41.1	49.7	15.4	6.7	4.7	22.9	0.6
Average	41.2	53.3	16.9	6.7	2.7	19.8	0.6

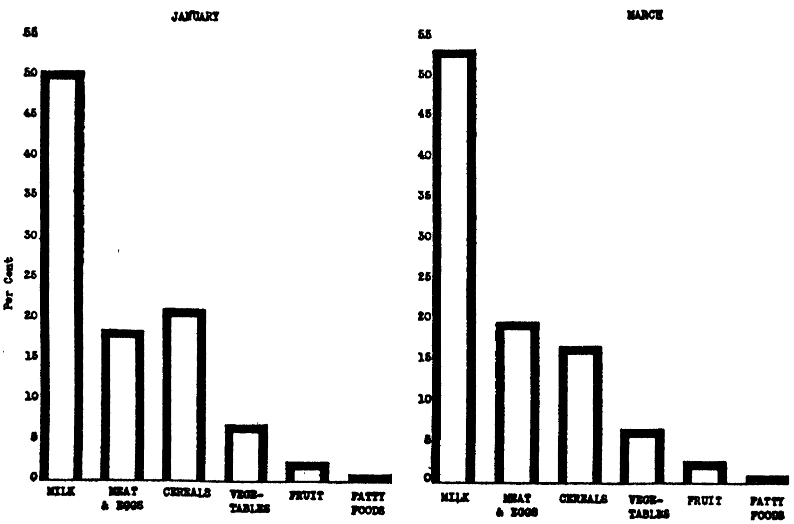

Fig. 1.—Sources of protein in the diets of individual children

The most important source of protein for children is milk. It not only contains an assortment of essential amino acids efficient in promoting growth, but the proteins of milk are the most completely digested of all food proteins. In this study milk was found to be the principal source of protein. It furnished slightly over 50 per cent of the total protein in both January and March. In Table 3 it may be seen that each child increased his milk consumption in March over January. The increase ranged from 11 to 46 per cent, with an average increase of 18 per cent. Table 4 shows that milk furnished a larger percentage of the total protein in March than in January in all but two cases. Although the actual number of grams of milk used by these two children was higher in March than in January, the increase in milk was relatively less than the increase of other food groups.

TABLE 3.—Comparison of the Milk Consumption for One Week in January and March

Child	January		March		Increase in March
	Cups	*Grams*	*Cups*	*Grams*	*Per cent*
Boys No.:					
1	3.0	710	.....	.....	.....
2	2.1	507	2.5	608	20
6	2.5	591	2.8	676	14
7	3.0	718	3.3	796	11
Girls No.					
3	1.4	342	1.8	432	26
4	2.3	548	2.6	615	12
5	2.4	565	3.5	830	47
8	1.9	449	2.6	612	36
Average	2.3	554	2.7	653	18

TABLE 4.—Percentage of Protein Derived from Milk During One Week in January Compared with the Corresponding Percentage During One Week in March

Child	January		March	
	Av. protein	Protein from milk	Av. protein	Protein from milk
	Grams	*Per cent*	*Grams*	*Per cent*
Boys No.:				
1	43.8	54.2	.....	.....
2	40.8	42.2	39.7	52.3
6	41.0	53.3	42.0	55.8
7	41.0	62.3	45.9	57.3
Girls No.:				
3	30.4	37.2	37.8	37.9
4	31.3	65.6	32.4	63.4
5	39.9	48.0	49.3	56.7
8	41.5	40.3	41.1	49.7
Average	38.7	50.4	41.2	53.3

According to Rose, eggs rank next to milk as a source of desirable protein in the diets of pre-school children. The protein of meat is also of high quality, but in no way superior to milk and eggs. As shown in Table 2, the percentage of protein derived from meat and eggs was 18.7 per cent in January, and 19.8 per cent in March.

TABLE 5.—Percentage of Animal and Vegetable Protein in the Diets of Individual Children

Child	January			March		
	Av. protein	Per cent animal	Per cent vegetable	Av. protein	Per cent animal	Per cent vegetable
	Grams			*Grams*		
Boys No.:						
1	43.8	72.2	27.8	....	....	....
2	40.8	64.5	35.5	39.7	72.7	27.3
6	41.0	74.3	25.7	42.0	76.9	23.1
7	41.0	78.3	21.7	45.9	79.5	20.5
Girls No.:						
3	30.4	60.0	40.0	37.8	69.8	30.2
4	31.3	71.0	29.0	32.4	68.1	31.9
5	39.9	73.6	26.4	49.3	75.2	24.8
8	41.5	63.4	36.6	41.1	73.3	26.7
Average	38.7	69.7	30.3	41.2	73.6	26.4

Due to the large amount consumed, cereal products may be considered as an important source of protein. Although none of them are equal in value to milk, eggs, or meat, they may all be made highly efficient by being supplemented with milk. In this study, cereals furnished 21.2 per cent of the total protein in January, and 16.9 per cent in March. In each season cereals supplied approximately the same amount of protein as meat and eggs together.

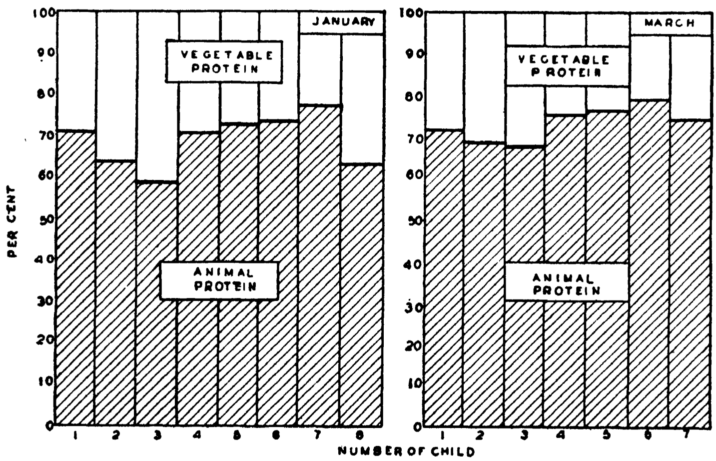

Fig. 2.—Percentage of animal and vegetable protein in the diets of individual children

It has been shown that the major part of the protein eaten was supplied by milk, eggs, meat, and cereals. A small amount, however, was furnished by vegetables and fruit. In January 6.8 per cent of the protein was furnished by vegetables, and 6.7 per cent in March. Fruit yielded 2.4 and 2.7 per cent in January and March, respectively. It is of interest to note that the percentage of protein derived from both vegetables and fruit remained virtually constant during both seasons.

A comparison of the percentage of animal and vegetable protein is given in Table 5; whereas Figure 2 presents this material graphically. The animal protein in the diets of these children in January averaged 69.7 per cent of the total. In March the average of animal protein had increased to 73.6 per cent. This percentage of animal protein agrees closely with data given by McKay, who found 69.2 per cent of animal protein in the diets of the private-home children, and also with data of Holt and Fales who report approximately two-thirds per cent animal protein.

Many authors find it convenient to express protein in terms of the percentage of total calories derived from protein. The percentage of calories supplied by protein in the diets of these children has, therefore, been determined. In Table 6 is shown the average calorie intake of each child with the percentage of calories derived from protein for both seasons.

TABLE 6.—Percentage of Calories Derived from Protein in the Diets of Individual Children

Child	January			March		
	Av. daily calories	Av. daily protein	Pct. of total calories	Av. daily calories	Av. daily protein	Pct. of total calories
		Grams			*Grams*	
Boys No.:						
1	1193	43.8	14.7	...	...	...
2	1180	40.8	13.8	1120	39.7	14.2
6	1357	41.0	12.1	1273	42.0	13.2
7	1349	41.0	12.2	1393	45.9	13.2
Girls No.:						
3	1022	30.4	11.9	1109	37.8	13.6
4	1062	31.3	11.8	1082	32.4	12.0
5	1238	39.9	12.9	1431	49.3	13.8
8	1307	41.5	12.7	1179	41.1	13.9
Average	1214	38.7	12.8	1227	41.2	13.4

In January the percentage of calories derived from protein ranged from 11.8 to 14.7 per cent, with an average of 12.8 and a median of 12.4 per cent. During March the corresponding figures varied from 12.0 to 14.2, while the average of 13.4 and median of 13.6 were both slightly higher than in January. McKay reports that for the entire group of orphanage and private-home children 12 per cent of the total calories were furnished by protein; whereas Holt and Fales give 15 per cent. The percentage for the children of this study also comes within the 10 to 15 per cent range which Sherman regards as sufficient for growth and maintenance in children.

SUMMARY AND CONCLUSIONS

The protein intake of eight healthy pre-school children, ranging in age from 19 months to 3 years, was obtained through a dietary study made by the individual method for a period of one week in January and one week in March. A summary of the findings shows:

1. The average daily protein intake for the entire group was 38.7 grams in January and 41.2 grams in March. The boys received 42 grams in January, as compared to 43 grams in March. The girls used 36 and 40 grams in January and March, respectively.

2. The average daily protein intake per kilogram of body weight for the entire group was 2.76 grams in January and 2.84 grams in March. The boys used 2.87 grams in January and 2.78 in March. The intake for girls in January of 2.64 grams increased to 2.88 grams in March.

3. The average daily protein intake per inch of body height for the entire group was 1.09 grams in January and 1.14 grams in March. The corresponding figure for the boys was 1.17 grams in January, as compared to 1.15 grams in March. The girls received 1.02 and 1.13 grams per inch in January and March, respectively.

4. The protein consumption of the children of this group was only slightly less than that reported in previous dietary studies.

5. The average protein consumption varied considerably from child to child. The lowest average daily protein intake for any child in January was 30.4 and the highest 43.8 grams, a difference of 13.4 grams. During March the corresponding figures were 32.4 grams as compared to 49.3 grams, a difference of 17.1 grams.

6. The protein intake of each child also varied considerably from day to day.

7. Milk supplied slightly over 50 per cent of the total protein, cereals 19 per cent, meat and eggs 19 per cent, fruit and vegetables 9 per cent, and fatty foods the remainder.

8. Approximately 70 per cent of the protein used by the entire group came from animal sources in January, as compared to 74 per cent in March.

9. During both seasons approximately 13 per cent of the total calories was derived from protein.

10. From the limited data of this study it would seem that a protein intake of 2.48 to 3.30 grams per kilogram of body weight is consistent with good physical development in pre-school children.

OUR AGRICULTURAL EXPORTS

J. I. FALCONER

Among other reasons for the low prices of our agricultural products is the falling off in our export trade. Normally, around 15 per cent of our total agricultural production goes to the export trade. For the past few years it has been much less. A reason for this may be found in the tariff boundaries and the restrictions on imports which have been imposed since the war, and more especially during the past 5 years, by nearly all nations—including those of western Europe which normally are the best markets for our exportable products. Germany, for instance, now has a tariff of over $1.50 per bushel on wheat.

From 1926 to 1928 we exported 22 per cent of our wheat crop; during the past 2 years we have exported only 12 per cent. For the last 6 months of 1932 the exports were only 19,000,000 bushels, as compared with 55,000,000 bushels in the same period of 1931. Part of this fall off in 1932 was probably due to the smaller crop of 1932.

TABLE 1.—United States Exports

Year	Wheat	Bacon, ham, and shoulders	Lard	Tobacco
	1000 bushels	*1000 pounds*	*1000 pounds*	*1000 pounds*
1920	311,601	821,922	612,250	467,662
1921	359,021	647,680	868,942	515,353
1922	235,307	631,452	766,950	430,908
1923	175,190	828,890	1,035,382	474,500
1924	241,454	637,980	944,095	546,555
1925	138,784	467,459	688,829	468,471
1926	193,971	351,591	698,961	478,773
1927	228,576	237,720	681,303	506,252
1928	151,976	248,278	759,722	575,408
1929	154,348	275,118	829,328	555,347
1930	149,154	216,953	642,486	560,958
1931	125,686	123,246	568,708	503,531
1932	82,000	83,000	546,000	411,000

Hog products exports have also fallen. This is especially true of bacon, ham, and shoulders. Our exports of the latter were only a little over 10 per cent of those of 1920. Lard exports have also fallen. It is apparent, therefore, that either we must curtail our production to a domestic basis, with the consequent loss through the abandonment of a part of our production facilities, or efforts must be made to bring about a revival of world trade.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

In February, both all-commodity prices and the prices of farm products reached new lows. In January of 1933, Ohio farm commodity prices were only a little above one-half those of January 1931. Factory employment was 59 per cent of the 1923 to 1925 average. Factory payrolls were only 40 per cent of the 1923 to 1925 average. The prices of farm products are at a lower level than that of the commodities which farmers buy, but the volume of output from the farm has decreased less than that from the factory; as a result, the income of farmers as a whole and that of laborers as a whole has fallen about the same.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	...	100	100	104	100	105	100
1914	99	100	101	102	102	102	105	107
1915	102	101	106	100	103	107	106	110
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	141	232	156	139	169	96	154	147
1929	139	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	128	130
1931	107	207	129	80	129	82	89	93
1932	95	178	110	57	92	70	63	67
1931								
January	114	212	137	94	133	...	104	115
February	112	215	136	90	...	...	96	85
March	111	219	134	91	...	82	98	104
April	109	215	133	91	119	...	102	97
May	107	211	130	86	...	...	96	90
June	105	207	129	80	...	...	92	93
July	105	207	128	79	115	...	84	86
August	105	207	127	75	...	...	86	90
September	104	205	124	72	...	...	82	87
October	103	199	122	68	116	...	77	86
November	102	196	120	71	...	...	79	93
December	100	194	119	66	...	...	72	88
1932								
January	98	191	118	63	100	...	69	81
February	97	189	116	60	...	...	64	68
March	96	189	114	61	...	70	64	67
April	95	183	113	59	94	...	64	65
May	94	177	112	56	...	...	61	63
June	93	174	110	52	...	...	59	61
July	94	171	109	57	90	...	63	67
August	95	172	108	59	...	...	66	73
September	95	177	107	59	...	...	64	67
October	94	177	107	56	84	...	61	68
November	93	171	106	54	...	...	61	66
December	91	170	105	52	...	...	60	59
1933								
January	89	165	105	51	75	...	55	64
February	88	...	104	49	...	60	53	57

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WOOSTER, OHIO, U. S. A.

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C. G. Williams

Director

Scene on Ohio Experiment Station Campus

TILE DRAINAGE IN THE ORCHARD

C. W. ELLENWOOD AND J. T. McCLURE

Inadequate soil drainage is frequently responsible for much mortality and low vigor in apple orchards. The use of fertilizer and other vigor-promoting practices is unlikely to give the desired results until the drainage is improved.

From an examination of trees dying from poor sub-surface drainage, it seems that the killing results from suffocation of the tiny root hairs submerged in water for long periods.

Experience in the apple orchards at the Experiment Station indicates that this trouble may not be evidenced for the first 5 or 6 years after planting. In two of the experimental orchards which later proved to be inadequately drained, there was no unusual mortality from poor drainage until 8 or 10 years after planting. About the time the trees in these two orchards began to bear fruit in commercial quantities, an occasional tree began to show yellow foliage. The leaves were usually smaller than on healthy trees.

SYMPTOMS OF "WET FEET"

The outward symptoms of this injury are not unlike those of girdling by any process, whether by winter injury, rodent injury, or some other cause. However, a rather general observation in the Station orchards seems to show that a tree injured by poor drainage may survive longer than one injured by the usual winter freezing. Furthermore, the two orchards at Wooster seem to show that winter injury may have been associated with "wet feet", especially in the case of some varieties.

OTHER ROOT TROUBLES

However, the type of root injury which caused most of the damage to Orchards C and K is distinct from the winter freezing frequently reported on sandy soils. Soil temperatures are usually several degrees lower during winter months in sandy soils than in clay or loam. Winter freezing of roots is more prevalent on dry soils than on moist soils. After drouth years when the moisture content of tree and soil is low, heavy damage to roots frequently occurs. In Orchard C, where the loss of trees due to poor drainage was experienced, most of the loss was on a plot heavily mulched with straw, although the winter temperature of soil mulched with straw averages several degrees higher than soil given clean cultivation or soil on which cover crops are grown. During the period when the greatest mortality of trees occurred, the moisture content of the soil during the growing season in both Orchards C and K was, no doubt, much above the average in other orchards at the Station. When injury caused by poor drainage manifests itself in the color of the foliage, the tree usually does not die that season. It may even come into foliage and set a crop of fruit the following year. However, a tree rarely survives the second season after the yellowing of the foliage is visible.

EXAMINATION OF ROOT SYSTEM

In removing filler trees after their tenth growing season in Orchard K, it was noted that frequently some of the larger roots would be almost devoid of root hairs. Occasionally an entire main root would be dead; whereas, the remaining roots would be normal. It can be readily understood that if any great portion of the root system was dead, injury would be noted in the foliage and general appearance of the tree when fruit-bearing age was reached. At the end of the ninth growing season 39 trees out of 435 had either died or were so near dead that it was obvious they would not survive the winter. Table 1 shows the apparent difference in varietal susceptibility to this type of injury.

TABLE 1.—Varietal Susceptibility of Apples to Root Rot*

Orchard planted 1922—Observations made October, 1930

Variety	Total trees	Trees showing root rot	
	No.	*No.*	*Pct.*
Arkansas	49	6	12.3
Grimes	105	11	10.5
Jonathan	56	2	3.6
McIntosh	56	4	7.1
Stayman	120	8	6.7
Winesap	49	8	16.3

*The term "root rot" is used here in a general physiological sense, rather than pathological.

PLANTING ARRANGEMENT OF ORCHARD

The planting arrangement in Orchard K was as follows: Permanent trees were planted in rows 38 feet apart with 40 feet between trees. The double filler system was used so that originally the trees stood 20 feet apart in the row with only 19 feet between rows. Before the orchard was planted the site had been used for general farm crops. The soil is Wooster silt loam; the contour is slightly rolling, with the slope tending from north to south. The fertility of the soil was good, the field being rated as productive for farm crops and not considered poorly drained.

For the first 6 years the trees made exceptionally rapid growth. As might be expected, associated with this vigorous growth a few trees were badly injured by freezing of the trunk, the bark splitting badly from the surface of the ground upwards for 18 inches in some cases.

At the end of the eleventh growing season (autumn of 1931), the trees were so large that it was almost impossible to drive a wagon, tractor, or sprayer between the rows. Accordingly, the filler row was removed. This left the planting arrangement of rows 38 feet apart and 20 feet between trees in the row.

TILE DRAINAGE NECESSARY

To write about expending money for tile drains during these strenuous times may seem entirely out of place to many orchardists, but this article is offered as a possible aid to those fruit growers who now find it necessary to protect a large initial investment with some additional expenditures for subsurface drainage. Only a limited amount of information is available on the benefits of orchard drainage, as compared with that published relative to

general farm crops, notwithstanding the fact that the orchard owner has many times the amount of capital invested per acre in the form of original cost of trees, planting, and care until production starts. A general farmer may lose part or all of a corn crop one year due to lack of drainage, but poor orchard drainage may mean the loss of the trees themselves, together with from 5 to 10 years of hard work.

Tile drainage is somewhat like fruit growing in that it requires a long-time investment. On the other hand, the results of drainage may be immediate, and the continuance of these results should extend for 100 years.

MAKE A COMPLETE PLAN

A tile drain system is buried underground, and failure to function properly is difficult and usually costly to remedy. It is, therefore, necessary to provide a complete plan of proper design before laying a tile. The design will be influenced by such factors as the purpose of drainage, character of surface and subsoil, the local rainfall, the topography of the land to be drained, the fall obtainable, and the outlet. The interaction of these factors is so complicated that the services of a competent engineer should be secured if the best design is desired. Future additions should be foreseen and provision made for suitable hookup with the system already installed. A detailed drawing of all tile drains is very essential in orcharding since tree roots may destroy part or all of a layout costing hundreds of dollars. No set plans can be fitted to all pieces of land. The best design is the one which properly drains the area in question and continues to function constantly for many years—in fact, indefinitely.

Our present discussion deals with the drainage of an orchard of approximately 4 acres. Beginning in 1932 this orchard was converted into a series of experimental plots wherein cyanamid was being tested as a nitrogen fertilizer. Since the experiment involved the securing of a considerable amount of soil analytical data, it was imperative that the soil-moisture conditions be as uniform as possible. Uniform soil drainage thus became necessary. There are eight rows with 29 trees in each row. A line of tile was laid between each two rows (as indicated by Fig. 1). The land slopes from northeast to southwest, and some tile drains, of which we have found no record, were placed in the depression before planting the orchard, as indicated on Figure 1 by "Old 4 In.". Much water drains onto this area from a large slope to the east.

The drainage problem consisted of:

1. Securing a suitable outlet.
2. Determining whether or not there was fall enough at all points.
3. Deciding on the location of laterals.
4. Estimating size of tile required.

Since no ditching machine was available, all the work was done by hand. Most of the time during which the work was in progress the soil was in good condition for tiling. The work was not greatly impeded by shale or stones at any place. However, since the laterals were located exactly in the tree row where the fillers had stood, the work of ditching was slowed up considerably by roots. Although the filler trees were pulled out by tractor a great many roots remained in the ground. The time consumed in digging was much greater than would have been required had the tiling been done before the orchard was planted.

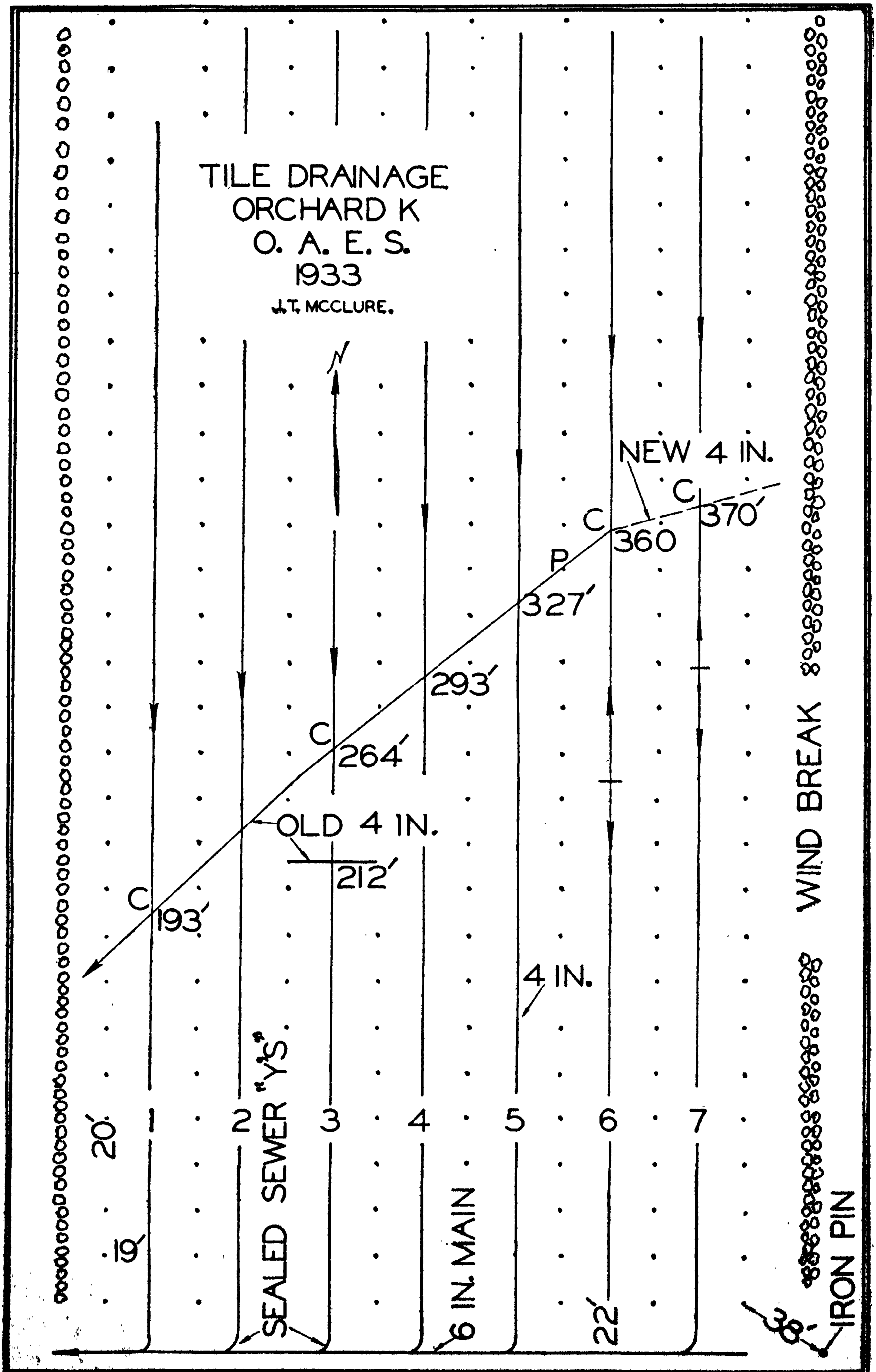
TILE DRAINAGE
ORCHARD K
O. A. E. S.
1933
J.T. MCCLURE.
N
NEW 4 IN.
C
370′
C
360
P
327′
293′
C
264′
OLD 4 IN.
212′
C
193′
4 IN.
WIND BREAK
20′
1
2
3
4
5
6
7
19′
SEALED SEWER "Y'S"
6 IN. MAIN
22′
38′
IRON PIN

Fig. 1

This experience emphasizes the practical difficulties encountered in tiling an orchard already planted where the filler system has been used. In fact, it is somewhat difficult to lay out a systematic drainage system on an orchard site even before the trees are planted if filler rows are to be set. The better plan is to tile the land first and then endeavor to make the planting arrangement fit in with the tiling system.

THE OUTLET

The outlet, which is not shown on Figure 1, lies approximately 300 feet directly west of the orchard on the property line along the public highway. At this point, a brick cross wall was constructed flush with the ground and sunk to a depth of 4 feet. The last tile of the main extends through this wall and is flush with it on the downgrade side. Entry of rabbits and other animals is prevented by a door of heavy-gauge sheet iron, 8 inches by 8 inches, hinged at the top so as to fall by gravity over the mouth of the tile. Water coming down the tile pushes it open. A short open trench permits the water to flow into the highway ditch and get away through a nearby culvert.

THE MAIN AND LATERALS

The 6-inch main extends in a straight line directly past the south end of the orchard, 22 feet from the last row of trees. Fortunately, the slope of the land permitted placing laterals in a north and south direction, the only practical way, since the trees were already in place. Laterals 1, 2, 3, 4, and 5 drain through to the main; whereas 6 and 7 are broken, the north ends draining into "New 4 In." at Stations 360 and 370, respectively, and the south ends into the new 6-inch main. The direction of water flow is indicated by arrows.

An old "4 in." is crossed by all new laterals. The distances from the 6-inch main to these intersections were determined, and connections were made between the new laterals and the "Old 4 In." at points C. The new laterals were connected to the new main by placing 6-inch sewer-tile "y's" in the main at points permitting the bending of the last 6 or 8 feet of the lateral downgrade. All lateral-main junctions were sealed with rich cement. An iron pin was placed in the windbreak from which all points and elevations in the system can be determined.

The heavy character of the surface soil and tightness of the subsoil required rather shallow placing of the tile. A depth of from 2 to 2½ feet was maintained for the laterals and of 3 to 3½ for the main.

It is not the purpose to suggest this tiling arrangement as a model to be followed indiscriminately. It may be stated, however, that in Orchard C similarly drained several years ago the results have been entirely satisfactory. Orchard C is made up of Stayman and Delicious. At the end of 10 years 25 per cent of the Stayman had been removed, mainly on account of poor soil drainage. Since this orchard was tiled in the same manner as Orchard K, there has been no further loss of the original or replanted Stayman trees.

It is expected that by tiling Orchard K further loss in trees from "wet feet" will be arrested. A secondary advantage in tiling Orchard K was manifested in the spring following the laying of the tile. During the latter part of March and early April, 1933, precipitation was above normal. Under like weather conditions a few years earlier, such spring work as spraying and hauling brush was accomplished with difficulty. Four horses were required to pull

a medium-sized sprayer when applying the dormant spray. During the early spring of 1933 one team could readily handle a much heavier sprayer. All other late-winter and early-spring labor was similarly facilitated because of the tiling. This orchard has from the time it was planted been maintained under the cover-crop system.

Fig. 2.—Lateral-main connection

Time may bring forward some defects in this system; for example, roots of trees situated along "Old 4 In." may eventually close it, although we have no evidence in hand to show that apple-tree roots will disturb a tile drain.

The tree at Point P will probably be the first offender and yearly observation of the "Old 4 In." at Station 327 will be made to determine just what is taking place relative to the roots disturbing the tile. Should the tile be clogged at this point, it will be possible from the records to effect a remedy at a minimum cost. If apple roots will enter a tile and continue to grow, it is conceivable that in years to come the roots of the permanent trees will have spread across the 19 feet between tree and tile and give trouble. However, the benefits secured in the meantime should be sufficient to cover the original cost of the system many times.

THE STATUS OF WHEAT BREEDING IN OHIO

C. A. LAMB

The Ohio Agricultural Experiment Station has an extensive program of wheat improvement in progress. The work is largely confined to the soft, red winter wheats. White wheats and a few spring varieties are being tested, especially in northwestern Ohio where they are best adapted, but no actual breeding is being done except with the soft red class. This work is of particular interest to the farmer and to the miller who buys the larger part of the crop.

But why develop a new wheat? Is there anything seriously wrong with present varieties? Undoubtedly, they are better wheats for Ohio than the older varieties they replaced. They are, however, by no means perfect. Ohio farmers plow up an average of 200,000 acres of winter wheat every spring because of winter injury. A part, at least, of this great loss in time, fertilizer, seed, and labor could be saved with a more winter-resistant variety. Diseases, such as smut, cause losses both through lowered yield and loss on grade. In many cases these diseases can be controlled through inborn resistance more effectively and more cheaply than by any other means. These factors, together with increase in yield and better agronomic characters in general, offer almost limitless possibilities in the line of improvement.

The wheat improvement program is largely one of hybridization. First, varieties are collected and carefully examined under Ohio conditions. Some excel in one characteristic and some in another. No one provides exactly what is wanted. At present, intensive study is being made of some 20 new lines from the United States, Canada, and Europe, with the object of later combining their good qualities with those of the best Ohio varieties.

Next, crosses are made—not at random, but with the definite object of obtaining certain desirable combinations of characters. This sounds like a simple procedure, but actually to produce exactly the combination wanted is a slow and laborious process. If the two lines differ only in 10 independent genetic factor pairs, probably a situation much too simple, less than one plant in each million of progeny would have exactly the inheritance desired. Millions of plants do not have to be grown, because large proportions of the undesirable lines can be eliminated on inspection; however, breeding, in spite of this aid, requires extensive work. Because geneticists have not yet solved the factor complexes responsible for such important characteristics as yield and quality, the breeder must still work more or less in the dark, guided only by general principles.

After crosses are made, they are grown for several generations without anything but a mass selection of desirable-appearing plants. There are both technical and practical reasons for this procedure. Today, progeny of 25 distinct hybrids are at this stage.

Individual plant selections from these progeny are next made. These are grown in pedigree culture; that is, seed from each plant is grown in a single 4-foot row where its general behavior and character can be studied. Large numbers can be discarded at this time, but many lines, apparently satisfactory, must be carried further.

The next step consists of single rod-row plots. Here, new lines get their first yield trials. They are kept in these rows until apparently pure; that is, until sufficient generations have been grown after the cross was made so that danger of further segregation, or sudden appearance of undesirable characters of one or the other parent, is practically eliminated. Here again it is possible to discard relatively large numbers of inferior lines. There are about 200 selections at this stage at Wooster and Columbus today.

Lines which survive the single rod row pass on to the replicated rod row; these are larger plots in which each selection is sown three times. This permits a more accurate measure of yield and other characters. Three hundred lines have reached this step in the program. The planting at Columbus is almost a duplicate of that at Wooster. Since conditions of soil and climate at the two locations are quite different, an idea as to the range of conditions over which a selection will be adapted is obtained by this procedure.

Occasionally a line will do well in the nursery but will give poor results when sown in the field, or vice versa. Therefore, in the final nursery test the selections are planted with an ordinary grain drill in order to duplicate as nearly as possible field conditions. Each strain is replicated five times in the test, and a number of the best commercial varieties are included in order to get a reliable measure of the value of the new lines. This planting is also duplicated at Columbus. Smaller rod-row nurseries on four of the Experiment Farms, scattered over the State, supply additional data.

After 3 or more years in the final nursery test, the best selections move on to the variety test proper at Wooster. As soon as sufficient seed is available, they are sown at Columbus also.

Ohio is not a large state compared to many in the Union, but within its boundaries are found wide differences in soils and quite significant differences in climate. Before a variety can be distributed, therefore, tests must be made in a number of localities. Twelve District and County Farms have been used for this work in recent years, and today there is a total of over 350 plots, aside from those at Wooster and Columbus, devoted to wheat variety test work. The results from these farms provide the final basis for deciding what new lines to reject and which ones to multiply for distribution.

Besides the work outlined, many problems are receiving special study. Most important of these is winter injury. Experiments are under way to determine the causes and the relative importance of each factor in winterkilling. A satisfactory method of inducing heaving in a cold chamber is being investigated. Also, an intensive study of the characteristics of the winter behavior of varieties has been started. Cooperating with the U. S. Department of Agriculture, the Station has grown the 30 varieties included in the new Eastern Winterhardiness Nurseries at four locations in the State. The sole object of these nurseries is to study the winter behavior of varieties from the northeastern United States over a wide range of conditions, and the results of a few years' work should give valuable information.

Disease resistance also receives special study. A small nursery is devoted entirely to producing artificial epidemics of the diseases which cause most injury in Ohio. This gives positive information as to the reaction of new selections before they are released.

Another special study which should be mentioned is the "Levels of Fertility Experiment". Here, new strains are being grown over a wide range of available plant nutrients, and results should indicate how they will behave on poor, medium, and good soils.

Finally, note should be made of the milling and baking tests to which new lines are subjected. Unless the miller is satisfied with the quality of the wheat, the farmer would lose his largest market. Therefore, no new line is released until it has proven itself satisfactory in this important respect.

Steps in Wheat Improvement Program. Ohio Agricultural Experiment Station

Time required in each stage		Place where this work is done	No. plots for harvest, 1933
1 - 5 years	Intensive Study of Varieties for Parent Material	W	20
1 year	Crosses to Combine Superior Characteristics	W (C)	20 —
3 - 5 years	Multiplication in Bulk	W	30
1 - 3 years	Individual Plant Selections (Isolation of Pure Lines)	W	—
1 - 3 years	Single Rod-row Test	W	200
2 - 5 years	Replicated Rod-row Test (3 replications)	W C	900 300
3 - 5 years	Final Rod-row Test (5 replications) — Milling and Baking Tests	W C O	1000 700 500
3 - 5 years	Variety Test	W C O	160 90 350
1 - 2 years	Multiplication for Distribution	W	—
		Total	4270

Minimum Time
(by overlapping) about 10 years

W=Wooster
C=Columbus
O=Outlying Farms

To summarize, the Ohio Station today has a total of about 700 distinct new lines, all from carefully planned crosses which are potentially capable of giving new combinations of characters superior in some particular respect to those of existing varieties. These are being vigorously selected on the basis of their adaptability, not only to the Ohio farm but also to the miller who will buy the grain. The aim is to give the farmer a good yield of wheat of such quality that the miller will pay him the best price for it; the extensive improvement program, with its thousands of plots in 14 locations in the State, guarantees that Ohio introductions, when released, will be a genuine improvement over older varieties, both for the farmer and for the miller who provides his market.

FACTORS INFLUENCING THE VITAMIN-B AND VITAMIN-G CONTENT OF HAYS[1]

CHAS. H. HUNT, P. R. RECORD, W. WILDER, AND R. M. BETHKE

There is considerable discussion at the present time concerning the quality of feeds. It is still true that all rations for livestock must be balanced and, for best results, balanced with quality products. The word quality has a relative meaning. The ingredients most often used to supplement feeds—that is, to bolster up their quality—are those having ample quantities of a complete protein and sufficient amounts of minerals and vitamins, or they are ingredients which, in combination with others, can amply supply the above factors. The chemical analysis does not reveal the true value of any feed.

In addition to the chemical composition, something should be known about the quality of the products that go to make up a feed. Since vitamins are very essential for all livestock and since they are factors which determine quality, they must be considered just as essential as protein or calcium or carbohydrates.

Hays or meals made by grinding the hays (alfalfa) are often used alone or in combination to make quality feeds, but hays vary in their "quality-producing" factors, depending upon the time of harvesting and method of curing. At the present time the quality of hays is judged by their color and leafiness, but this may be subject to varying interpretation. Consequently, some better criterion for judging quality is needed.

It has been shown that the vitamin-G content of milk[2] and eggs[3] can be increased by using feeds of high vitamin-G content. Since hays are often used as a source of vitamin G in feeds, naturally, the next step in our investigation was to make a study of the factors that affect the vitamin-G content of hays. In this paper the factors affecting the protein and vitamin-B and vitamin-G content of hays, together with a comparison of Ohio and Colorado alfalfa meals, are given. The outstanding facts of the investigation are presented in Table 1.

[1]The authors wish to thank the Bureau of Plant Industry, U. S. Department of Agriculture, the Department of Farm Crops, the Ohio State University, and the Department of Agronomy, the Ohio Agricultural Experiment Station, for cooperation in furnishing samples for this investigation.

[2]Hunt, Chas. H. and W. E. Krauss. 1931. Jour. Biol. Chem. XCII:631.

[3]Unpublished data obtained by R. M. Bethke and associates.

TABLE 1.—Chemical and Biological Analyses of Hays

No.	Sample	Date of cutting	Crude fiber	Protein	Units of vitamin G per gram of hay*	Units of vitamin B per gram of hay*	Remarks
			Pct.	*Pct.*			
1	Alfalfa	May 31, '32	25.27	20.14	13.3	2.5	....
2	Alfalfa	June 10, '32	32.41	17.60	13.3	2.0	....
3	Alfalfa	June 21, '32	34.76	15.59	10.0	1.6	....
4	Alfalfa	July 28, '32	32.51	12.91	8.0	2.5	Second cutting; leafhopper injury.
5	Alfalfa	Sept. 10, '32	23.49	19.92	16.6	2.0	Third cutting.
6	Clover	June 10, '32	23.20	15.67	13.3	1.6	....
7	Clover	June 21, '32	28.73	12.26	10.0	2.0	....
8	Timothy	June 12, '31	25.92	8.49	10.0	0.83	....
9	Timothy	June 25, '31	28.78	7.09	4.0	0.66	....
10	Timothy	July 13, '31	30.42	5.25	2.8	0.50	....
11	Timothy	June 18, '32	25.65	6.65	3.3	1.10	....
12	Alfalfa	July 21, '32	....	18.17	10.0	....	Second cutting.
13	Alfalfa	July 21, '32	....	15.41	5.0	....	Second cutting (0.68 in. rain).
14	Alfalfa (Colo.)	....	23.24	17.07	13.3	2.0	....

*A unit of vitamin B or G is the weight of the substance which, when fed to rats under standard conditions, will produce an increase in weight of 3 grams per week.

DISCUSSION

The data in the table show that as the plant matures, the protein and vitamin B and vitamin G decrease and the crude fiber increases; therefore, the quality decreases. It is very likely that hays will never be used as a source of vitamin B in feeds, and, since this vitamin is present in very small amounts, the data are merely presented because of their association with vitamin G. Therefore, the discussion will center around the vitamin-G content of hays.

The man in the field or the person in the market for hays or meals has no ready way of determining the vitamin-G content or the protein content. Is there any correlation between the vitamin content and the protein content and any other factor which can be seen with the eye? It has been observed that a high protein and a high vitamin-G content are correlated, in a general way, with a good green color and leafiness. As the greenness fades, due to the stage of maturity of the plant, the protein and vitamin-G content also decrease. This correlation of vitamin G with greenness is only relative and varies with the amount of bleaching; for, if the bleaching is done with light, then there is no correlation between vitamin-G content and greenness.

Each hay varies in this respect; for example, a similar greenness in alfalfa and timothy hays would not of necessity indicate the same vitamin-G content. Timothy hay cut early and having a light green color may have as high a

vitamin-G content as an early-cut alfalfa or clover having a much deeper color. The data show that rain leaches out more vitamin G and color than protein, although the amount of protein removed by rain depends upon the stage of maturity of the plant when cut. Of two hays having approximately the same protein content, the one cured without rain may have 40 to 50 per cent more vitamin G than one which received a heavy rainfall while being cured. Samples 1 to 12 were cured in subdued light indoors; whereas Sample 13 was cured in the sun and received a heavy rain during the curing process. The data indicate that rain reduced the protein content considerably and the vitamin-G content 50 per cent. Also, the Colorado product does not have a higher protein and vitamin-G content than the Ohio products.

The above data were obtained from growth experiments with rats. In order to obtain further data as to the comparative values of Ohio- and Colorado-grown hays, day-old chicks were used as the experimental animals. In this case, the rat unit data were tested by actual feeding experiments with the chicks. The alfalfa meals were fed as 10 per cent of the ration and constituted the sole source of vitamin G in the chick rations.

TABLE 2.—Chemical and Biological Analyses of Alfalfa Meals

No.	Sample	Crude fiber	Protein	Units of vitamin G per gram of hay	Weight of chick at end of 8 weeks (average)	Remarks
		Pct.	*Pct.*		*Gm.*	
1	Alfalfa (Colorado)........	30.59	14.25	10.0	454	Meal
2	Alfalfa (Colorado)........	16.20	20.56	16.6	528	Leaf meal
3	Alfalfa (Ohio)............	16.58	20.25	16.6	517	Leaf meal
4	Alfalfa (Ohio)............	27.69	16.00	10.0	466	Meal
5	Alfalfa (Ohio)............	23.07	20.31	6.6	397	Leaf meal (0.68 in. rain)

All meals fed were composite samples of three or more lots, except the Ohio leaf meals, where only one sample was used. The results are given in Table 2. The data show that the Ohio products are equal in protein and vitamin-G content and produced comparable growth in chicks to that of the Colorado products.

CONCLUSION

As the hays mature, the protein and vitamin-G content decreased; that is, the quality became poorer.

A high protein content and a good green color are correlated with a high vitamin-G content, provided all other influencing factors are the same during the process of curing.

Rain removes more vitamin G and color than protein.

Colorado meals, as used in this investigation, do not have a higher protein or vitamin-G content than the Ohio products.

FOREST FIRES—AN AREA CLASS STUDY

B. E. LEETE

It is the primary object of every forest fire control organization to discover and suppress incipient fires as quickly as possible. Just how far the Division of Forestry is succeeding in this purpose with its resident forest fire wardens and a half-completed fire-tower "net work" has been brought out by a recent study. The basic material used in connection with this project consisted of the written reports of 1878 forest fires extinguished in 12 counties in southern Ohio for the 5-year period from 1927 to 1931, inclusive. The original fire reports, after having been received from the local fire wardens, were in nearly all cases checked in the field, so that the data are believed to be quite reliable.

Although the size of the average forest fire was 27.0 woods acres for the 1878 fires that were extinguished during the 5 years, this fact alone fails to give a very adequate picture of the situation as it really exists. Of course, it is unfair to say that merely because a fire was big that, therefore, the towermen, wardens, and fire fighters were at fault. Certain difficulties of the situation may have been quite insurmountable. On the other hand, large fires usually represent inefficiency, slow response, poor fire-fighting technique, or inadequate communication and equipment. It, therefore, seemed profitable to break up the "average" figure into several component parts and examine the resultant figures. This is what is attempted in the present study.

Six arbitrary size classes were selected as follows: Fires of 0 to 0.2 acres, fires of 0.3 to 10.0 acres, fires of 10.1 to 30.0 acres, fires of 31 to 100 acres, fires of 101 to 500 acres, and fires over 500 acres. It will be seen, if the accompanying table is examined, that 52.8 per cent of all the fires (992) was held on 10 acres or less; this represents a high grade of performance in the majority of cases. However, the most significant figure of the whole study is this: Only 6 per cent of the 50,756.1 acres of woods burned in the 5 years can be ascribed to fires of the first two size classes.

Nearly one-fourth of all the fires is found in the 10.1 to 30.0-acre class. These fires collectively burned nearly 7,000 acres of woods. They averaged 15.4 acres each—nearly five times as large as the average fire of the preceding 0.3 to 10-acre class, and the damage per fire and cost of suppression were correspondingly larger. Of course, in considering the cost of suppression, it must be remembered that this item does not vary in direct proportion to the area burned but rather in proportion to the length of its perimeter (or the distance around it), which is quite a different matter. Cost per acre is always very high for small fires and very low for large ones.

Thirty per cent of the woods area burned is accounted for by fires that range in size from 31 to 100 acres. The average size per fire for this class is 48.8 acres, and the fires collectively accounted for approximately 15,500 acres of scorched woods, or 54 per cent more than all of the fires from the preceding three size classes. The damage per fire amounts to $140.11, and the suppression bill is no longer small.

TABLE 1.—Total Number of Fires, Area Burned, Damage to Woodlands, and Cost of Suppression

Fires grouped according to size classes for the 5 years 1927 to 1931, inclusive

Size class Acres	Number of fires		Woods area burned			Damage to woods			Cost of suppression			
	Total	Per cent	Total, Acres	Per cent	Acres per fire	Total	Per cent	Per fire	Total	Per cent	Per fire	Per acre
0 to 0.2	87	4.6	6.0	0.0	0.07	$ 4.50	0.0	$ 0.05	$ 217.33	0.9	$ 2.50	$36.22
0.3 to 10.0	905	48.2	3,068.6	6.0	3.4	7,245.00	5.5	8.01	5,158.61	20.7	5.70	1.68
10.1 to 30.0	454	24.2	6,996.0	13.8	15.4	17,561.50	13.2	38.68	5,521.85	22.1	12.16	0.79
31 to 100	317	16.9	15,488.5	30.5	48.8	44,415.00	33.4	140.11	7,293.58	29.2	23.01	0.47
101 to 500	111	5.9	21,797.0	43.0	196.4	51,419.00	38.7	463.23	6,216.24	24.9	56.00	0.28
Over 500	4	0.2	3,400.0	6.7	850.0	12,280.00	9.2	3,070.00	546.54	2.2	136.64	0.16
Total	1,878	100.0	50,756.1	100.0	....	$ 132,925.00	100.0	....	$24,954.15	100.0	....	....
Average	375.6	....	10,151.2	....	27.0	$ 26,585.00	....	$ 70.78	$ 4,990.83	....	$ 13.29	$ 0.49

In the 101 to 500-acre class, less than 6 per cent of the fires, by number, account for 43 per cent of the burned area. This class, of a scant 6 per cent by number, still is responsible for swelling the suppression bill by 24.9 per cent. The fires average 5½ times as costly as those of the preceding four classes.

Four times during the 5 years a fire of more than 500 acres occurred; the average was 850 acres, or one and one-third square miles apiece. The cost of suppression per fire of $136.64 is indeed large, but the damage per fire was $3,070.00. Moreover, fires can only be stopped by fighting them. Whole townships used to be swept by fire before any provision had been made for organized forest fire control. Now it is rare for any fire to be burning the second day.

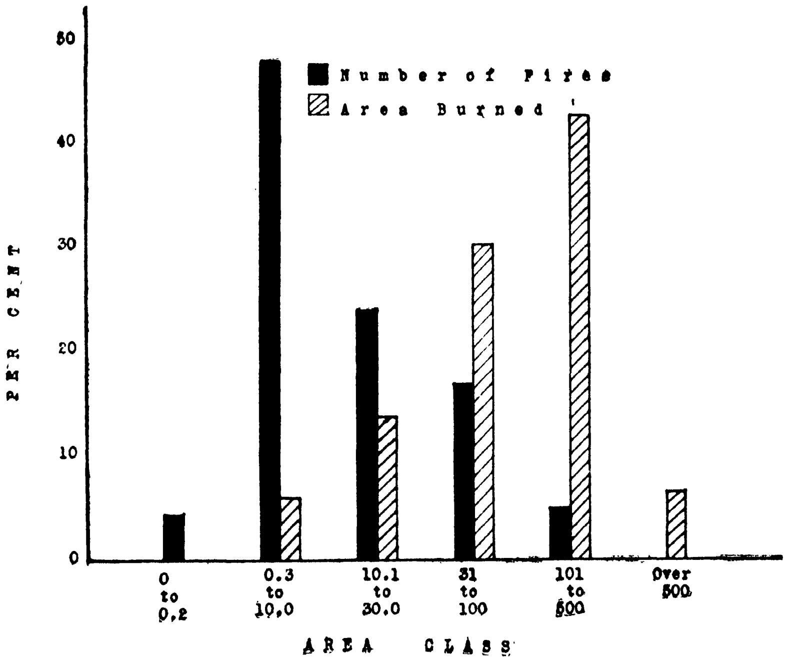

Fig. 1.—Per cent of total number of fires and area burned, by area classes, 1927 to 1931

In conclusion, experience has shown time and again, that local residents do not discover nearby incipient fires as quickly as a good towerman several miles away. The towerman usually arrives in time to be the one to give the first alarm, and his work is greatly speeded if there is telephone communication. An expenditure of three cents per acre per year on the million acres of woods now under protection would permit the completion and maintenance of the tower system and would practically eliminate the over-sized fires of the three largest size classes. In so doing 80 per cent of the present damage would be prevented.

SOME FACTORS OF SUCCESS IN SHEEP RAISING

F. L. MORISON

A study was made of the fine-wool sheep enterprise in southeastern Ohio during the years 1930-1932. During this period complete flock costs were secured on approximately 70 farms each year, or a total of 214 records in all. These costs included feed, pasture, labor, shelter, interest, and miscellaneous cash costs. Wide variation was found in the amount of profit or loss made. The average price of wool in this section declined from about 25 cents in 1930 to about 13 cents a pound in 1932. In spite of low prices for wool and lambs a few flocks succeeded in showing a return above all costs each year. Some of the factors contributing to the profit or loss of individual flocks are indicated in Table 1.

TABLE 1.—Comparison of 10 Most Profitable and 10 Least Profitable Flocks

3-year averages

Item		10 most profitable flocks	10 least profitable flocks	All flocks
Number of flock-year records	......	30	30	214
Sheep per flock (number shorn)	......	117	108	116
Number of ewes bred	......	69	48	61
Lambs raised per 100 ewes bred	......	91	68	82
Lambs raised per 100 sheep	......	54	30	43
Wethers per 100 sheep	......	0	15	10
Deaths of mature sheep per 1000	......	25	76	47
Inventory value of sheep per head	Dol.	5.14	4.10	4.59
Grain fed per sheep	Lb.	82	47	51
Dry roughage per sheep	Lb.	212	245	218
Per cent legume hay	Pct.	47	33	42
Feed and pasture per sheep	Dol.	2.81	2.51	2.57
Man labor per sheep	Hr.	2.3	2.8	2.6
Total costs per sheep	Dol.	4.14	3.89	3.98
Per cent of lambs cross-bred	Pct.	27.6	17.0	26.1
Per cent of lambs sold before Oct. 1	Pct.	20.3	4.4	21.6
Average value per lamb, Oct. 1	Dol.	3.36	2.37	2.93
Lamb income per sheep	Dol.	1.81	0.72	1.26
Total income per sheep	Dol.	4.48	2.24	3.21
Costs less income other than wool	Dol.	1.60	3.26	2.55
Wool per sheep	Lb.	10.70	8.61	9.44
Cost per pound of wool	Dol.	0.15	0.38	0.27

In the most profitable flocks, 91 lambs were raised per 100 ewes bred, as compared with only 68 lambs in the flocks showing the poorest return. In the least profitable flocks, 15 per cent of the total number of sheep was wethers (2 years old and over at shearing time); whereas no wethers were kept in the better-paying flocks. There were about three times as many deaths of mature sheep in the least profitable flocks as in the other group, indicating a difference in feeding and care. The sheep in the better flocks received 75 per cent more grain per head and a better grade of hay than did those making the poorest return. A somewhat larger proportion of the lambs raised in the 10 best flocks were cross-bred. The fact that these lambs brought a better price on the market or were more thrifty and desirable in weight on October 1 (the end of the record year), together with the larger number of lambs raised per 100 sheep, improved the income on these farms.

The number of pounds of wool per sheep is another significant difference. If income from mutton and manure is subtracted from total costs and the remaining figure considered as cost of producing wool, it will be noted that the most profitable flocks would have broken even had their wool sold at 15 cents per pound; whereas the wool from the least profitable flocks would have had to bring 38 cents per pound in order that all costs be covered. The average price received for all wool sold during the 3 years was 18.8 cents.

COMPARATIVE PRICES OF OHIO FARM PRODUCTS

J. I. FALCONER

The accompanying table shows a comparison of the prices of several Ohio farm products, as of April 15, 1933, with those of the pre-war period 1910-1914. Such a comparison is of interest at this time since one of the objectives of the Farm Bill recently passed by Congress is to restore the prices of farm products to a pre-war parity with those of the products which farmers buy. Since in April of 1933 the price level of the commodities which farmers buy was, as a whole, at the same level as that of 1910-1914, it would appear that the objective, assuming that the general price level does not change, is to restore the prices of farm products to approximately the level of 1910-1914. This would mean for Ohio, 96 cents for wheat, 62 cents for corn, $7.62 per cwt. for hogs, and $1.48 per cwt. for milk. The latter figure for milk is the price received for all milk—condensery and surplus, as well as market milk.

TABLE 1.—Prices of Ohio Farm Products

	Units	Average price			Index of price (1910-1914=100)			
		1910-1914	1925-1929	1932	1921-1924	1925-1929	1932	April 1933
Chickens	Lb.	$ 0.12	$ 0.23	$0.12	175	196	106	83
Lambs	Cwt.	6.05	11.96	4.90	166	210	83	73
Milk	Cwt.	1.48	2.61	1.21	159	169	82	71
Beef	Cwt.	6.02	8.64	4.65	110	146	78	65
Potatoes	Bu.	0.77	1.43	0.56	156	192	75	70
Eggs	Doz.	0.22	0.34	0.17	144	150	73	60
Milk cows	Head	53.00	82.00	37.00	114	159	72	59
Butterfat	Lb.	0.25	0.44	0.17	158	180	68	60
Sheep	Cwt.	4.10	6.51	2.22	126	167	57	42
Horses	Head	163.00	108.00	93.00	64	66	57	60
Wool	Lb.	0.22	0.40	0.12	171	190	56	60
Hogs	Cwt.	7.62	10.77	3.82	108	145	51	46
Wheat	Bu.	0.96	1.40	0.45	124	145	47	60
Oats	Bu.	0.40	0.45	0.19	107	112	46	50
Corn	Bu.	0.62	0.87	0.26	118	142	43	57
Hay	Ton	14.20	11.64	4.74	93	84	34	33
All Ohio Farm Products	....	....	....	......	131	153	63	59

The table also shows that in April of 1933 the prices of Ohio farm products were, as a whole, 41 per cent below those of the pre-war average, varying for individual commodities from 67 per cent below for hay to 17 per cent below for chickens. It would appear, therefore, that to bring prices back to the 1910 to 1914 level would mean a greater advance in the price of some products than of others.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

April and May saw a greater rise in the price of Ohio farm products than has occurred in any 2-month period since 1929. By the middle of May farm product prices had regained their losses of the past 6 months. In March of 1933 the price of Ohio farm land was 59 per cent that of 1910 and just about at the level of 1900. There was a 15 per cent decline during the year 1932. A study in three counties of the State reveals that farm foreclosures and voluntary transfers of title to avoid foreclosure were 18 per cent less in the first 4 months of 1933 than in 1932.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	99	100	101	102	102	102	105	107
1915........	102	101	106	100	103	107	106	110
1916........	125	114	123	117	113	113	121	121
1917........	172	129	150	176	140	119	182	198
1918........	192	160	178	200	175	131	203	243
1919........	202	185	205	209	204	135	218	266
1920........	225	222	206	205	236	159	212	242
1921........	142	203	156	116	164	134	132	136
1922........	141	197	152	125	145	124	127	136
1923........	147	214	153	135	166	122	134	149
1924........	143	218	154	134	165	118	133	150
1925........	151	223	159	146	165	110	159	164
1926........	146	229	156	136	170	105	155	176
1927........	139	231	154	131	173	99	147	163
1928........	141	232	156	139	169	96	154	147
1929........	139	236	155	138	169	94	151	161
1930........	126	226	146	117	154	90	128	130
1931........	107	207	129	80	120	82	89	93
1932........	95	178	110	57	92	70	63	67
1931								
January...	114	212	137	94	133	....	104	115
February..	112	215	136	90	....	....	96	85
March.....	111	219	134	91	....	82	98	104
April......	109	215	133	91	119	....	102	97
May.......	107	211	130	86	....	....	96	90
June.......	105	207	129	80	....	....	92	93
July.......	105	207	128	79	115	....	84	86
August....	105	207	127	75	....	....	86	90
September.	104	205	124	72	....	....	82	87
October....	103	199	122	68	116	....	77	86
November.	102	196	120	71	....	....	79	93
December..	100	194	119	66	....	....	72	88
1932								
January...	98	191	118	63	100	....	69	81
February..	97	189	116	60	....	....	64	68
March.....	96	189	114	61	....	70	64	67
April......	95	183	113	59	94	....	64	65
May.......	94	177	112	56	....	....	61	63
June.......	93	174	110	52	....	....	59	61
July.......	94	171	109	57	90	....	63	67
August....	95	172	108	59	....	....	66	73
September.	95	177	107	59	....	....	64	67
October....	94	177	107	56	84	....	61	68
November.	93	171	106	54	....	....	61	56
December..	91	170	105	52	....	....	60	96
1933								
January...	89	164	104	51	75	....	55	64
February..	87	164	102	49	....	....	53	61
March.....	88	163	101	50	....	59	53	56
April......	88	....	100	53	....	....	59	58

AGRICULTURAL PRODUCTION NOT THE ONLY CAUSE FOR LOW PRICES OF FARM PRODUCTS

V. R. WERTZ

Much has been said and written recently to the effect that agriculture has caused her own low prices by increasing her output. Even if agriculture had increased her output, this would be only a part of the cause for low prices for agricultural products. Prices are the result of demand and supply conditions. When supply of farm products is measured in terms of demand for them and in the light of lessened industrial production, agriculture has probably over-produced in the last few years, and it can be said that agricultural prices would be higher today if farmers had curtailed production. In the absolute or physical sense, however, agriculture has not over-produced.

What are the facts? From a recent study of the situation V. R. Wertz, of the Department of Rural Economics of the Ohio Agricultural Experiment Station, sets forth some interesting information on the causes of the present low prices for farm products. From the period 1910-1920 to the period 1920-1930, the physical volume of sales of all products from Ohio farms (that is, bushels of wheat and potatoes, hundredweight of milk, dozens of eggs, pounds of tobacco, etc.) increased 3 per cent. In this same length of time people living in Ohio cities, towns, and villages increased 26 per cent. This increase in output of 3 per cent in farm products was produced on 10 per cent fewer farms and on 5 per cent less land. The physical volume of agricultural sales from Ohio farms in the last 13 years (1920-1932) has increased only 2 per cent over the 1910-1920 average.

Figures showing the net volume of agricultural production for the United States as a whole are available since 1919. These figures show that the net volume of farm products sold and consumed by people living on the land increased 10 per cent from the 7-year period 1919-1925 to the last 7 years, 1926-1932. Although the physical volume of agricultural production increased 10 per cent over this period, population (or the number of stomachs to be filled) in the United States increased 11 per cent. In the absolute or physical sense, then, agriculture has not over-produced in the last few years.

If, then, agriculture has not over-produced, why have the prices of farm products averaged 25 per cent lower in the last 7 years than from 1919 to 1925, 44 per cent lower in the last 3 years than in the 7-year period 1919-1925, and 59 per cent less in 1932 than in 1929? One answer is that all prices have been on the decline over this period. The prices of all commodities at wholesale fell 22 per cent from the period 1919-1925 to the period 1926-1932, 34 per cent from 1919-1925 to the last 3 years, and stood 32 per cent lower in 1932 than in 1929. One answer then to the question as to what has caused lower agricultural prices in the last few years is that farm prices have followed the trend of all prices. But this does not explain all of the drop which has taken place in agricultural prices.

The other principal reason for the low price of farm products is that the demand for these products has decreased. The European demand for our staple products, due to high tariffs and low purchasing power abroad, has been on the decline in the last few years. In the last 7 years, 1926-1932, the physical volume of our agricultural exports had declined 14 per cent from the previous 7-year period, 1919 to 1925. In the last 3 years exports have averaged 25 per cent under those for the period 1919 to 1925; and in the last crop year, 1931 to 1932, our exports of farm products stood 8 per cent under those of 1929. This decline in exports of farm products has, of course, had a decided influence on our home markets by placing a larger volume of farm products on them.

The purchasing power of those who buy in our home markets has also decreased. The laborer's income in the United States has been decreasing rapidly in the last 2 or 3 years. Payrolls in the United States (that is, the amount of money in the laborer's pay envelope) averaged 8 per cent less in the 7-year period, 1926-1932, than in the previous 7 years, 1919-1925. In the last 3 years, payrolls averaged 31 per cent less than those from 1919 to 1925 and in 1932 averaged 58 per cent less than in 1929. This decline in the laborer's income has influenced the demand for farm products in two ways. It has influenced the demand for farm products as a whole and also the demand for extra quality or fancy farm products. The laborer who in 1932 had 42 cents to spend for every dollar he had to spend in 1929 was more interested in getting the necessary quantity of food and clothing for his family than in buying fancy products. This condition has tended to lower the premium paid for high quality or fancy farm products.

Mr. Wertz concludes from these facts that farm prices are not low because farmers have increased their production but because the foreign and domestic demand for farm products has fallen and because the general price level has been on the decline.

WHAT TO DO IF CORN MUST BE PLANTED LATE

G. H. STRINGFIELD[1]

Over a period of 20 years at Wooster, the average reduction in corn yield due to late planting has been about 5 per cent for a delay of 10 days after the optimum planting date. It has been about 20 per cent for a delay of 20 days, and about 40 per cent for a delay of 30 days. The use of early varieties for late planting merely makes matters worse as far as grain yield alone is concerned. Experiments in Wayne, Lucas, Paulding, Henry, and Hamilton Counties, with few exceptions, indicate that early varieties are less productive than medium-maturing varieties, regardless of whether planting date is early, medium, or late. However, when very late planting is necessary, early varieties must be used if the danger of soft corn at harvest is to be lessened. Data taken by the U. S. Bureau of Plant Industry show that, with late planting, the medium-maturing varieties may be expected to be nearly as much later than the early varieties as would be the case if the planting were done at the normal time. The real variety problem for very late planting, then, is, "How early a variety should be used?"

A delay of a month in planting is likely to delay the silking period about 2 weeks. If a variety normally silking 2 weeks earlier than the adapted local corn is planted, however, a reduction in potential yield of at least one-third would follow. If a variety is used which is about a week to 10 days earlier in maturity than locally adapted corn, the potential reduction in yield due to variety would be about 10 to 15 per cent. This corn would still mature later than the normal ripening date for medium-maturing sorts if it is planted a month, or even 3 weeks, after normal planting date, but it could be hastened a few days by a hill application of about 100 to 150 pounds per acre of fertilizer such as a 2-12-6 or a 0-14-6. On most soils the hill fertilizer would help considerably toward making up the loss in yield due to the earlier variety. A gain of from 6 to 16 bushels per acre, depending upon the soil and season, may reasonably be expected from this treatment.

[1]In cooperation with the Division of Cereal Crops and Diseases, U. S. Bureau of Plant Industry.

From the experimental data available on the problem of delayed corn planting, the agronomists at the Ohio Agricultural Experiment Station feel that some such compromise as suggested above would be a far safer gamble than the introduction of extremely early varieties, even if planting is delayed a month after the normal date. In some localities, the corn normally grown on the uplands could well be shifted to the lowlands this year. A variety that has become adapted to heavy uplands will be several days earlier than that adapted to adjacent, more loamy bottoms. In many communities, early varieties are grown regularly by certain farmers. These varieties should be used to the fullest extent in such a spring as this.

For fields not likely to be planted until a month after the normal planting date in the locality, seed adapted 50 to 100 miles farther north would be much safer than local sorts as producers of marketable grain, but a large loss in yield would be taken if seed from as much as 200 miles north were used.

Local corn may be used for silage even under greatly delayed planting. Furthermore, one should not send away for early seed after his ground is ready for planting but should plant the best available local corn.

Special Days to be Held During August at the Experiment Station, Wooster, Ohio

DAIRY DAY - August 11

POTATO DAY - August 17

ORCHARD DAY - August 18

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 517. A Survey of Ohio Orchard Soils Relative to Phosphorus Distribution and Acidity, by J. H. Gourley and R. M. Smock. The available phosphorus content of the soils from 12 Ohio orchards is given, as well as the effect of cultivation and the addition of phosphorus on the distribution of available phosphorus.

Bulletin 518. Studies on the Nutritive Value of Milk. II. The Effect of Pasteurization on Some of the Nutritive Properties of Milk, by W. E. Krauss, J. H. Erb, and R. G. Washburn. Studies were made on the effect of pasteurization on the vitamin content, the hemoglobin-building power, the curd tension, and the growth-promoting and calcifying properties of milk.

Bulletin 519. A Study of the Ash Constituents of Apple Fruits During the Growing Season, by E. F. Hopkins and J. H. Gourley. Extension chemical analyses of the ash of apples are given. The correlation of nitrogen content of the fruit and the mineral content in the ash with physiological breakdown is briefly discussed.

Bulletin 520. The Use of Formaldehyde Dust in Growing Seedlings, by J. D. Wilson and P. E. Tilford. This bulletin includes a discussion of the various factors which must be considered in using formaldehyde dust as a soil disinfectant, together with some specific recommendations for certain organisms affecting seedlings.

Bulletin 521. Roadside Marketing of Agricultural Products by Ohio Farmers, by C. W. Hauck and H. M. Herschler. Various factors influencing the success of roadside marketing are given. Some possibilities opened up to the farmer by this method of marketing are also suggested.

Bulletin 522. Control of Alternaria Blight of Ginseng with Bordeaux Mixture and Injuries Accompanying Its Use, by H. A. Runnels and J. D. Wilson. A report of 5 years' work with the use of bordeaux mixture as a control of Alternaria blight is presented. Factors contributing to the injurious effects, as well as the beneficial one, are discussed.

Bulletin 523. Sources of Market Milk and Butterfat in Ohio, by C. G. McBride and T. K. Cowden. The study combines an analysis of census data with a survey of the sources of milk and butterfat marketed in Ohio. The census analysis deals with changes in numbers of dairy cows and the relation of population to demands for fluid milk.

Bulletin 524. The Potato Scab-gnat, *Pnyxia scabiei* (Hopkins), by Harry L. Gui. There is a description and life history of the potato scab-gnat given. In addition, factors influencing the extent of injury caused by the insect and methods for the control scab-gnat are briefly discussed.

The Bimonthly Bulletin

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Ohio Agricultural Experiment Station

WOOSTER, OHIO, U. S. A.

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Free Bulletin

C. G. Williams

Director

Floral Garden at the Ohio Experiment Station

THE WHEAT FIELD INSECT SURVEY—1933

J. S. HOUSER

Annually since 1918, the entomologists of the State University, the State Department of Agriculture, and the State Experiment Station have cooperated in making a survey of the wheat fields of the State. Primarily this survey has been for the purpose of determining the status of the Hessian fly, although attention has been given to other insect pests as well.

It is highly important that it be ascertained in advance of the time for seeding fall wheat if a heavy brood of Hessian fly is resting in the stubble of the cut crop in order that measures may be taken to avoid the serious damage almost certain to occur. Farmers will recall the outbreak of 1920 when 44 per cent of the wheat was infested and heavy financial losses were sustained. In 1932, the average infestation of all the fields surveyed was 35 per cent, but the damage to the crop was not severe because the season was unusually favorable to wheat and the robust, vigorous plants produced a good yield in spite of the relatively high infestation of fly.

In both instances, 1920 and 1932, the records will show that the entomologists accurately forecasted these outbreaks on the basis of the findings of the wheat field survey of the year previous and suggested that early seeding be avoided as a means of control. These warnings were fairly well heeded, and there seems little doubt that had they been disregarded the losses, particularly in 1920, would have been excessive.

In this connection it may be said that it is a source of genuine gratification and encouragement to the entomologists to note that wheat growers as a whole are coming to depend more and more upon the findings of the annual wheat field survey to guide them and that the suggested safe seeding dates are for the most part quite generally adhered to.

It is no uncommon thing during years when Hessian fly is abundant to find fields sown later than the suggested fly-free date that are rather seriously infested with fly. When this occurs, it is not to be wondered that the owners of such fields express doubt as to the effectiveness of proper timing of seeding as a control measure. Such infestations may be accounted for by any one of three reasons, but in order to understand clearly these reasons a brief statement must be made concerning the seasonal behavior of Hessian fly.

At the time wheat is harvested the Hessian fly is in the pupa or flaxseed stage. It remains so under normal conditions until about mid-September in northern Ohio and late September in the southern part of the State, then there emerges from the flaxseeds, the fragile, gnat-like adult insect which visits young growing wheat and deposits a number of eggs on the blades of the plant. These eggs soon hatch and the larvae feed on the tender tissues at the base of the stem. With the approach of cold weather, the larvae change to flaxseeds, in which stage the winter is passed. A new brood of flies emerges the following spring and spreads to other parts of the same field or to neighboring fields. With these facts in mind it may be easily understood:

(1) That a field of wheat sown after the flies of the fall brood have emerged and have perished before depositing their eggs on it may be entirely free from fly in the fall of the year but may become seriously infested the following spring from a flight of flies from a nearby field.

(2) That if volunteer wheat is abundant, this may be infested in the fall and the spring brood of flies may spread the following spring from this source to nearby fields of wheat which were not infested the previous fall.

(3) That the emergence of the fall brood of flies may be delayed by drouth and that wheat sown on or after the approved date may become infested. During those seasons when Hessian fly threatens and when drouth prevails immediately preceding the fly-free date, it is wise to delay the time of seeding a few days—if possible until rains have caused the flies to emerge.

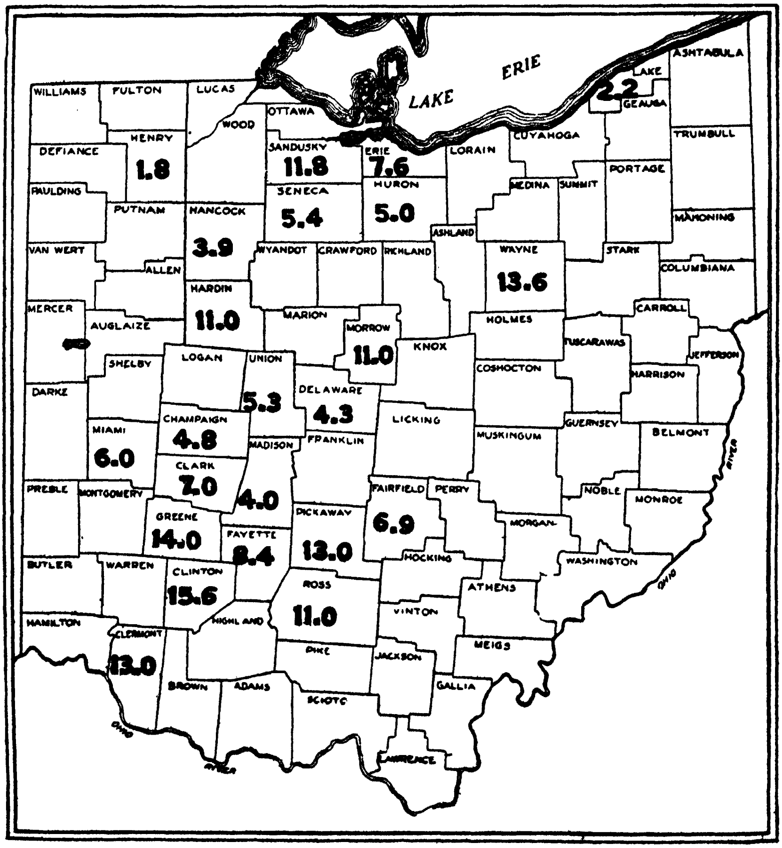

Fig. 1.—The figures indicate the percentage of wheat straws infested with Hessian fly in the counties visited in the 1933 survey

The survey which has just been completed indicates that Hessian fly is much less abundant this season than it was last year. The average for the entire State of all the fields surveyed in 1932, as has been stated previously, was 35 per cent; whereas this year the state-wide average has dropped to 8.1

per cent. The average infestation of 75 fields surveyed this season in Ohio by the Federal Bureau of Entomology is 8.0 per cent. This survey constitutes a portion of the annual survey made by the Bureau of the entire wheat belt. The Federal survey comprises an area extending east and west over the north central part of the State and includes a considerable number of additional fields in the southwestern section of the State. It is gratifying that the results of the two surveys corresponded so closely.

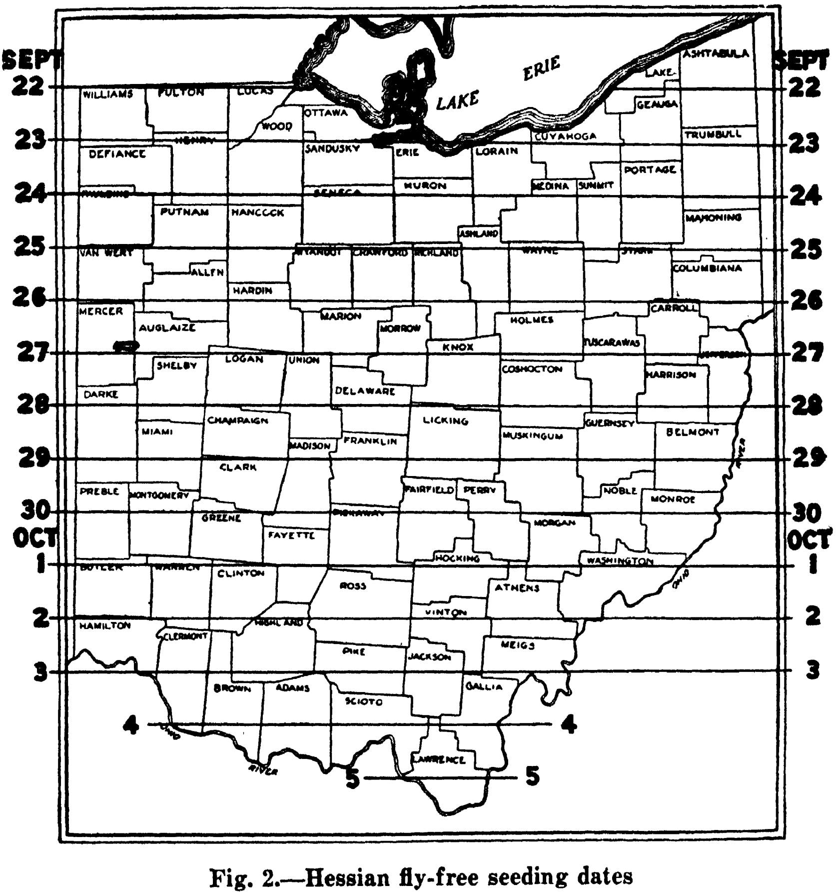

Fig. 2.—Hessian fly-free seeding dates

It was found in some of the fields surveyed that parasitic insects had destroyed the Hessian fly in the flaxseed stage, which offers still further encouragement that the fall crop will not be seriously menaced. Of the counties that were surveyed both last year and this, only one showed an increase this season. Last year 7 per cent of the wheat of Ross County was found to be infested with fly; this year an 11 per cent infestation was recorded. The greatest reduction in infestation occurred in Henry County where the record dropped from 39 per cent last season to 1.8 per cent this season.

The interpretation the entomologists place upon the records secured this year is that the Hessian fly hazard is low for the crop to be sown this fall. However, we feel it would be unwise to depart widely from the suggested safe seeding dates. To do so affords the Hessian fly undue and unnecessary advantage to increase its numbers, since, with the contemplated decrease in acreage this fall, there will be a tendency for the emerging flies to seek out the fields that are sown and concentrate on them. Furthermore, no particular advantage is gained from earlier seeding since the agronomists have found that the fly-free date corresponds quite closely to the date of seeding which may be expected to return maximum yields.

SAVING WHEAT FROM WINTER INJURY

C. A. LAMB

Ohio farmers plant over 2,000,000 acres to winter wheat each fall. This represents a very large investment in seed, fertilizer, and labor. Every winter some of this investment is lost; sometimes it is only a small percentage and, in other years, as much as two-thirds of the entire acreage sown. On the average, during the last 33 years, approximately 10 per cent of the winter wheat acreage has been plowed up, and the Ohio farmers have lost the seed and much of the fertilizer that were used on these 200,000 acres. Add to this loss the time and labor which gave no return, and it is evident that this is a very serious problem.

The first step in the control of this trouble lies in a study of the causes. Wheat may fail to survive the winter in Ohio for one or more reasons. Occasionally, low temperatures may be the direct cause of the death of the plants. However, this factor is probably of minor importance in this State. On the Great Plains Area, cold is the dominant factor in winter wheat losses, but as we move eastward this becomes less and less the major cause of injury, and secondary factors become more and more important. Alternate freezing and thawing is probably the most potent factor in most seasons in Ohio. Damage from this cause is due largely to heaving; that is, to "pulling" of the plants and consequent breaking of the root system. Drying out then kills the plants.

A sudden drop in temperature, especially after a rather prolonged spell of mild weather, is another cause of injury to winter wheat. Flooding or formation of ice sheets over the plants very commonly results in spots in a field killing out. This has doubtless been observed by every farmer.

Two avenues are open for control of this trouble. In the first place, the farmer can improve his cultural practice and eliminate as far as possible the soil factors which contribute to injury, and, also, he can give his plants the best possible start in the fall so that they can withstand more severe conditions. The second means of control lies in the production of a more winter-resistant variety. This is a problem for the plant breeder.

Drive through the country in the spring at the time when winter injury is most apparent, and it is very evident that fields differ greatly in the survival of

wheat plants. A little study seems to indicate very clearly that the greatest injury occurs where the plants had a poor start in the fall or where drainage was faulty. Attention to these two factors would reduce losses very considerably.

To give wheat plants a good start in the fall three factors are to be considered. The first is preparation of the seedbed. Insofar as farm work will permit, land for wheat should be carefully fitted before seeding. Early plowing and fitting of small-grain stubble land is especially desirable. This insures a good quick start for the seedlings and is reflected in stronger fall growth. Secondly, wheat should be liberally fertilized. This again has the effect of producing stronger, sturdier plants to enter the winter dormant period. Finally, wheat should be sown as early as possible after the date set for avoiding the Hessian fly. Early sown wheat has a distinct advantage over that sown later. Strong fall growth is important because larger plants can withstand more unfavorable conditions. The protection afforded the surface of the soil by well grown tops minimizes the injurious effect of alternate freezing and thawing and helps hold a good snow cover which gives an excellent protection against injury.

Drainage is a serious problem on many farms in important wheat-growing areas of Ohio. On fields where water lies for any considerable time or where the soil remains saturated for several days after a rain, damage is much more likely to occur, especially that damage caused by alternate freezing and thawing. Every effort should be made to improve drainage conditions on the fields where winter wheat is to be sown.

Intensive study of the causes of winter injury and the effect of various adverse conditions on the wheat plant are being made by the Ohio Experiment Station at Wooster in connection with the wheat breeding program. From this work it is hoped that in time more specific information will be available as to control of the difficulties. To this end the Station is also cooperating with the U. S. Department of Agriculture, through the Eastern Wheat Winter-hardiness Nurseries located at 23 locations in 13 states and the Province of Ontario in Canada. Four of these nurseries are located in Ohio, and they should furnish valuable information not only as to causes of winter injury but also on the variations in response of varieties developed in different regions.

Given the best of varieties and as nearly ideal soil and cultural conditions as possible, there will still be losses from winter injury. No amount of care can save every field in a season such as Ohio suffered in 1927-1928. However, this should not discourage the farmer too much. Over a period of years, careful attention to every detail that will help the wheat plant to escape injury is bound to result in a very material decrease in acreage abandoned. This, in turn, will mean the saving of many thousands of dollars. The Experiment Station is engaged in an extensive breeding program to produce a more winter-resistant variety and has made considerable progress. A more hardy wheat, however, is not the only avenue of attack on this problem, and the farmer can do much by following the suggestions given. The rush of fall work may make it impossible to get all the wheat sown early or to allow thorough preparation of every field, but, with ideal conditions as a goal, every grower should strive and plan to give his winter wheat the best start possible. Let every farmer try to save his share of the 3,000,000 bushels which represent the average toll of the winter season in Ohio.

WEED CONTROL IN THE ASPARAGUS PLANTING

R. M. SMOCK

Weed control during the cutting season is a problem that faces every asparagus grower. Numerous chemicals have been employed in an attempt to meet this difficulty. In recent years there have been some trials with calcium cyanamide (sold commercially as "Cyanamid") for this purpose. After being applied to the moist soil, calcium cyanamide breaks down into urea, ammonia, and finally into nitrates. While still in the cyanamide form, it exerts a partial sterilizing effect on the soil. When used in sufficient quantity, it will kill shallow-rooted annual weeds and most weed seeds that it comes in contact with. Since it is a nitrogen fertilizer containing 22 per cent nitrogen, it has an advantage over other chemicals used for weed control. The sterilizing effect of the material apparently is dissipated before it reaches the root zone of the asparagus.

An experiment was laid out in a bed of Washington Rust Resistant asparagus in the 1933 season to study rates and methods of application of this material for purposes of weed control. The soil is a Wooster silt loam.

The treatments were as follows:

Plot 1: 500 pounds granular Cyanamid per acre in an 18-inch band on the row.

Plot 2: 500 pounds pulverized Cyanamid per acre in an 18-inch band on the row.

Plot 3: No treatment.

Plot 4: 750 pounds granular Cyanamid per acre in an 18-inch band on the row.

Plot 5: 750 pounds pulverized Cyanamid per acre in an 18-inch band on the row.

Plot 6: 1000 pounds granular Cyanamid broadcast over the whole plot.

Plot 7: 1000 pounds pulverized Cyanamid broadcast over the whole plot.

Plot 8: 250 pounds pulverized Cyanamid per acre in an 18-inch band on the row.

The treatments were made on May 25, 1933. The soil was moist and the weeds (principally chickweeds) were one to 2 inches high. There were showers on May 26 and 29.

Almost complete control of annual weeds was obtained throughout the cutting season in Plots 1, 2, 4, 5, 6, and 7. There was apparently no difference in effectiveness between the granular and the pulverized forms. Row applications seemed more feasible than broadcast ones since cultivation can free the "middles" of weeds and an economy in material is thus effected. Yield records were not kept but there was no apparent reduction in yield even with the 1000-pound applications.

For adequate control with this material the weeds should not be over 1½ inches in height and the soil should be moist. Application while the weed leaves are still moist with dew should increase the value of the material.

Cultivation into the soil is not necessary. On loam soils, applications of 500 pounds per acre applied in an 18 to 20-inch band on the row should prove sufficient; whereas, on lighter soils, smaller applications should be equally efficient.

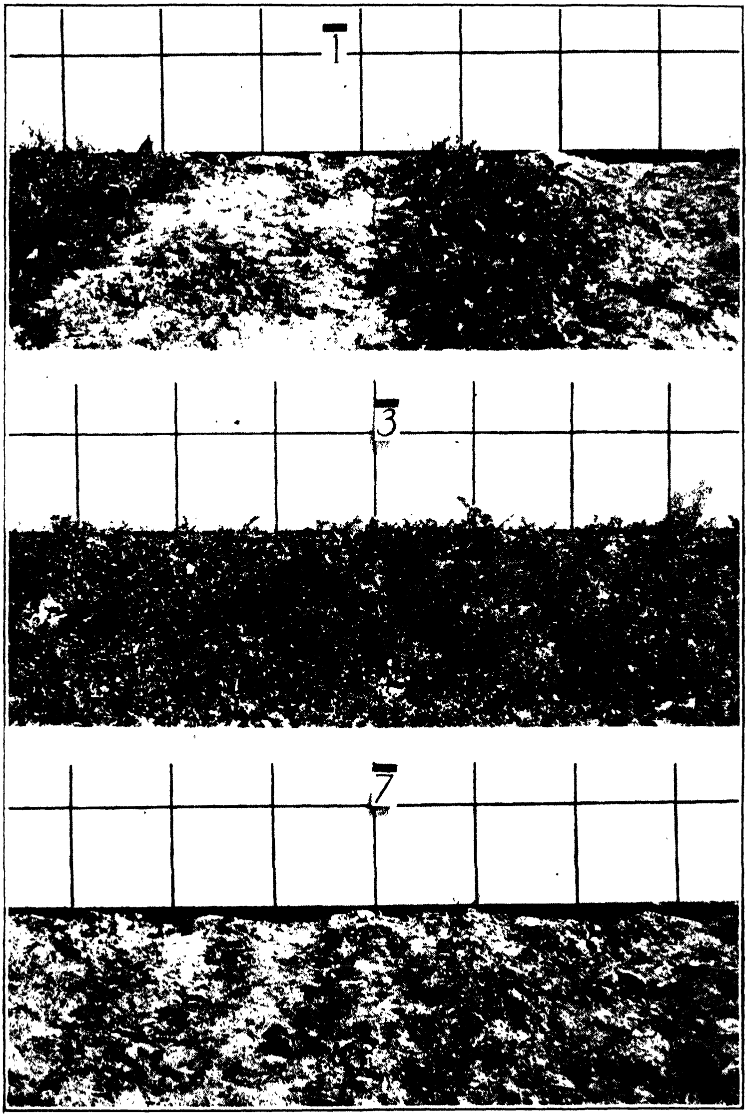

Fig. 1.—Cyanamid treatment of asparagus for weed control

Plot 1—500 pounds granular Cyanamid per acre in 18-inch band on row
Plot 3—No treatment
Plot 7—1000 pounds pulverized Cyanamid per acre broadcast

SHOULD THE MINERALIZATION AND VITAMINIZATION OF MILK BECOME GENERAL?

W. E. KRAUSS

Within the past few years, due to our newer knowledge of nutrition, emphasis has been placed upon those properties of foods not usually found listed in the older tables of chemical composition. Considerable emphasis has also been placed upon some of the mineral elements which occur in foods in rather minute amounts. Milk, along with a great many other foods, has received its due share of consideration.

Foods of all descriptions have been vigorously exploited. In general, dairy products have not been thus exploited. This is due largely to the fact that dairy products in themselves are so universally accepted as essential constituents of the diet that they have held an unparalleled position in the eyes of the medical profession, public health officials, welfare organizations, and the public in general. Recently, however, this unique position of milk has been somewhat endangered by attempts to enrich milk in factors already present in sufficient quantity and by adding materials long known to be deficient (and in spite of which deficiency the value of milk as a food has suffered no deterioration). A brief glimpse of the possibilities that exist, some of which have been carried out or proposed, will enable us to visualize the situation a little more clearly.

Vitamin A can be added to milk in the form of a liquid concentrate. Vitamins B and G, likewise, can be added as a liquid. No definite attempt to add vitamin C has as yet come to the writer's attention, but, with the isolation of vitamin C at the stage it now is, such a proposal may soon be looked for. Vitamin D is being added directly in the form of a liquid concentrate or through the medium of ultra-violet light and indirectly by feeding cows irradiated yeast. No one has as yet suggested the need for an additional source of vitamin E to that ordinarily found in the human diet.

Mineralization of milk has confined itself to three elements: iodine, iron, and copper. Advocates of iodine and iodine-containing products are urging the use of this element in the feeding of dairy cattle, not only because of any benefits the cow may receive but because of the resulting "iodized milk" which may help to solve the goiter problem. Demonstrations made in many laboratories showing that milk is deficient in iron and copper have led many to believe that these two minerals need to be added to milk.

This brief survey serves to show that there are rather strong actual and potential tendencies toward mineralizing and vitaminizing milk. The question which naturally arises as a result of this is, "Can the addition of minerals and vitamins to milk as it is ordinarily produced be justified?" To answer this question the extent to which milk is depended upon to furnish the various minerals and vitamins in question must be considered.

MINERALIZATION

That some relationship between iodine and goiter exists has been established beyond doubt. It has also been definitely shown that the iodine content of milk varies according to the geographical location of the point of production, and this, in turn, is correlated with the iodine content of the soils and

crops of that region and with supplemental iodine feeding. Regions of iodine deficiency are quite definitely bounded, and for years the use of known amounts of iodine has been advocated for these regions. The goiter problem is already sufficiently complicated without introducing into the field another iodine-containing material, in which the amount of iodine is difficult to control and more difficult to determine. It would seem to be a function of a group of investigators in dairy problems to study the fundamentals of iodized milk production and to determine the iodine content of market milk in order to allow the medical profession to be guided in its course of action along therapeutic lines.

Much the same attitude can be taken toward the addition of iron and copper to milk. It has been repeatedly demonstrated that young animals will develop nutritional anemia if placed at weaning time on a diet of cow's milk and that the development of anemia can be prevented by adding copper and iron to the milk. Does this necessarily indicate that infants receiving cow's milk need to have it fortified with iron and copper? It has been demonstrated that new-born infants have a considerable storage of iron and copper which serves to tide them over until the time when adequate iron- and copper-containing foods can be added to the diet. It is true that many infants are nursed too long or receive nothing but cow's milk over too long a period, but isn't that a matter for education and medical supervision? From the adult standpoint the fortification of milk with iron and copper would seem to be an entirely superfluous procedure, except in the treatment of certain anemias in which it was desired to administer iron and copper through the medium of milk. In this connection it is interesting to note that in a report of the Council of Pharmacy of the American Medical Association it is stated that a review of the literature fails to reveal that the addition of iron and copper is of any therapeutic advantage for man.

VITAMINIZATION

A glance at standard tables will show that milk is rated as an excellent source of vitamin A, a fair to good source of vitamin B, a variable source of vitamin C, a poor source of vitamin D, an excellent source of vitamin G, and that it contains vitamin E. Such tables are, of course, not accurate because the feed of the cow plays a very important part in determining the amount of each vitamin, except B and G, in milk. We have shown, for instance, that milk may vary in vitamin-A content from 400 units per quart to 1500 units per quart, depending on whether the sample was taken at the end of the winter-feeding period or during the pasture season. It is also well known that pasteurization reduces the vitamin-C content of milk materially. No definite values can, therefore, be assigned to the vitamin potency of milk. But does this justify the addition of various vitamins? Insofar as vitamins A, B, C, G, and E are concerned, it would seem not. Under modern systems of infant feeding there is only a relatively short period when milk constitutes the sole diet. Orange juice, tomato juice, strained vegetables, egg yolk, and finely milled cereals are soon included, as well as some anti-rachitic agent. Vitamin deficiency diseases, except rickets, are rare in children of this country, although a deficiency may exist without being apparent in definite symptoms. Dr. Icie G. Macy and Dr. Julia Outhouse, of the Children's Fund of Michigan, in a

paper on the vitamin content of milk used in infant feeding, made this significant statement: "The adherence of women throughout pregnancy and lactation to dietaries rich in fruit, vegetables, dairy products, glandular tissues, and the like, together with the early presentation of vitamin-carrying foods to the infant, serve as the most potent factors in the production of the nutritionally stable child." This statement came after a study had been made showing that human milk and cow's milk contained approximately the same amounts of vitamin A and that cow's milk contained about twice as much vitamin B as did human milk.

The recommendation made by Dr. Macy for women during pregnancy and lactation might be translated to good effect into feeding practices for cows during pregnancy and lactation. Therein lies a field for present and future intensive study.

In adult nutrition, since only a relatively small amount of the total vitamin intake comes from milk, should the intake of vitamins become too low it would be largely through ignorance or lack of funds, because the facilities for obtaining the various vitamins are readily available.

Aside from these technical considerations it is doubtful if the promiscuous addition of various minerals and vitamins to milk would meet the approval of the consuming public which is already well sold on the virtues of milk. Rather than increase the demand for milk, it would throw suspicion around a product which in their estimation has been considered a perfect food. Furthermore, such a procedure would tend to lose the support of other interests whose products go hand in hand with the use of milk and would tend to invite their attack.

The one exception to all this applies to vitamin D. Practically all natural foods are devoid of vitamin D. Eggs produced under proper conditions of feeding and management and certain marine products are fair to good sources of this factor. The amounts of these foods commonly consumed, particularly by children, are not sufficiently great to meet the needs of the body for vitamin D. It has been necessary in the past, therefore, to depend upon special vitamin preparations or upon ultra-violet light to obtain an adequate amount of this factor. In spite of the availability of many good, reliable sources of vitamin D, rickets and dental caries resulting from malnutrition are still too prevalent. In view of this, steps have been taken by numerous investigators to increase the vitamin-D content of common articles of food like milk and bread. This field has been developed to the extent that milk containing sufficient vitamin D per quart to prevent or cure rickets can now be obtained on the open market.

When the amount of money invested in equipment and the extensive clinical tests that are being made on the product are considered, it is apparent that vitamin-D milk is here to stay, provided the medical profession and public health officials endorse it and can exercise satisfactory control measures.

Assuming that the principle of vitamin-D milk is sound and that satisfactory methods for producing such milk are now available, there remains the problem of control. What assurance does the consumer have that the milk purchased as vitamin-D milk contains the specified amount of vitamin D? To determine the amount of this factor in a given sample of milk is a laborious and time-consuming procedure. Until the determination of vitamin D can be placed on the same basis as the determination of the butterfat or bacteria

content, assurance that the milk will measure up from day to day to the standards set must rest largely on confidence in those responsible for vitamin-D milk production. Careful selection of licensees, reasonable supervision, and frequent assays should also be expected.

SUMMARY

The general mineralization and vitaminization of foods, including milk, would further complicate an already complicated situation. Vitaminization and mineralization of foods probably cannot be justified except where natural foods fail to furnish these vital factors. This is especially true of milk. To add various vitamins and minerals to milk haphazardly would, in our opinion, jeopardize the unique and excellent position which this product now enjoys in the eyes of the general public and the medical profession. In spite of the intriguing mystery and glamor that surround some of the newer discoveries in nutrition, we must not lose sight of the fact that plain, ordinary milk is the best single food we have and is thus considered by all. The fact that a sufficient intake of calcium cannot be obtained except by the inclusion in the diet of some form of milk or cheese places these dairy products on a pedestal by themselves. However, the incidence of rickets is still greater than it need be. In the past we have depended upon such antirachitic agents as cod-liver oil, viosterol, and sunshine, natural and artificial. It is not because of the ineffectiveness of these sources of vitamin D that rickets is still with us. Rather, it is because of insufficient or unfaithful use of these materials, for which condition parents are probably chiefly responsible. Whatever the explanation may be, the fact remains that the incidence of rickets is still too great and will continue to be until some cheap, generally available, agreeable source of vitamin D is provided. Vitamin-D milk seems to offer promising possibilities of meeting these requirements.

RETURNS PER ACRE IN CATTLE FEEDING. V.

PAUL GERLAUGH AND H. W. ROGERS

During the winter of 1932-1933 two lots of yearling steers were fed at the Madison County Experiment Farm to learn more about the use of oats in cattle-fattening rations.

Lot 1 was fed a ration of corn silage, full-fed, a protein supplement of equal parts of cottonseed meal and whole soybeans, and mixed clover and timothy hay. This ration is the same as was used during four previous trials, excepting that 2 pounds of cottonseed meal were used as the supplement.

Lot 2 was fed half as much silage as the full-fed silage lot consumed and all the ground oats they wanted, as well as a full feed of mixed hay. The results of the feeding period are shown in Table 1.

A comparison of strength and weight of the new and laundered shirts is given in Tables 2 and 3. All of the shirts showed a loss in bursting strength after wearing and laundering. Shirts E and F were stronger than the other shirts, as judged by these endurance tests. Shirt A showed the least resistance to breaking and bursting strength tests.

All the shirts shrank as a result of the first laundering and continued to shrink with additional laundering, as was shown by measurement made after they had been laundered 10 times.

TABLE 2.—Tests Made on New and Laundered Shirts

	New						Worn and laundered 10 times					
	A	B	C	D	E	F	A	B	C	D	E	F
Breaking strength												
Wet												
Warp	82	74	96	77	110	147	70	96	121	97	129	157
Filling	43	60	65	61	78	66	18	49	45	48	60	54
Dry												
Warp	56	82	74	76	113	128	63	81	94	74	108	134
Filling	39	47	34	50	39	47	29	44	37	40	49	50
Weight, ounces per sq. yard	2.89	2.81	3.03	2.89	3.25	3.28	2.97	2.89	3.16	3.13	2.85	3.53
Strength-weight factor												
Wet	43	48	53	47	58	63	31	43	41	36	55	52
Dry	29	46	35	43	46	52	30	50	52	46	66	57
Bursting strength												
Wet	115	125	152	178	170	180	61	75	54	84	78	81
Dry	69	108	93	107	132	116	81	89	80	124	163	128
Shrinkage, per cent												
Warp	......	......	......	......	......	......	9.37	4.16	6.25	4.16	6.25	5.21
Filling	......	......	......	......	......	......	1.56	1.56	1.56	1.56	3.12	4.68

TABLE 3.—Percentage Change in Breaking and Bursting Strengths After Laundering

	A	B	C	D	E	F
Breaking strength						
Wet						
Warp	−14	+29	+26	+25	+17	+ 6
Filling	−58	−34	−29	−20	−23	+18
Dry						
Warp	+13	+ 1	+26	− 1	− 4	+ 5
Filling	−27	− 7	+10	−20	+25	+ 5
Bursting strength						
Wet	−29	−28	−47	−30	−40	−29
Dry	−11	−30	−41	−22	− 4	−28

Summary.—The results of this study indicate that there is some correlation between price and quality. This holds true especially in the very highest priced and the very lowest priced shirts. There was not such a definite relationship shown by shirts in the group costing from one to two dollars. In this study Shirts E and F, costing $2.50 and $3.50, respectively, and Shirt A, costing $0.48, showed the highest correlation between price and quality. This was judged by the strength-weight factor of the new and of the worn and laundered shirts, the permanency of the luster, the cut and style of the shirt, and the standards of construction.

LIFE INSURANCE COMPANIES HAVE LARGE LAND HOLDINGS

F. L. MORISON

A study of the detailed annual reports of the country's principal life insurance companies shows the extent to which these concerns have become real estate owners in recent years. On January 1, 1933, 19 insurance companies owned a total of 1,172 farms in Ohio, comprising more than 175,000 acres. One company alone had 273 farms, undoubtedly one of the largest land holders in the State. In 1932 these companies took title to 529 farms through foreclosure or deed in lieu of foreclosure, as compared with 269 farms in 1931, 179 farms in 1929, and 58 in 1927. Thus, the bulk of these holdings is of rather recent acquisition. Sales by insurance companies have been relatively few and scattered. Only 88 sales were completed in 1932, but these were at sufficiently low prices to have a depressing effect on the farm real estate market.

Most of the foreclosed farms owned by insurance companies are in the western half of the State. Paulding County has been hit hardest in this respect; it has 151 of these insurance company farms, or about one-eighth of the state's total. A map giving the location of all these farms shows the greatest concentration in an area extending from Defiance, Paulding, and Putnam Counties southeastward through Hancock, Hardin, Marion, Logan, and Union and then southward into Madison, Fayette, and Highland Counties.

Twenty-eight insurance companies own mortgages on Ohio farm real estate, aggregating more than 50 millions of dollars. This comprises approximately 20 per cent of the total farm mortgage debt in Ohio. Insurance companies have been withholding from the farm credit field in this State, as indicated by the fact that they loaned less than $2,000,000, including renewals and extensions, on this kind of security in 1932 as compared with more than $6,500,000 in 1928. Their Ohio urban real estate mortgage holdings, however, increased year by year up to 1931; but in 1932 only 45 per cent as much was loaned as in 1931.

Most of these institutions report the number of farm mortgages owned by them. Companies owning a total of 10,536 farm mortgages at the beginning of the year 1932 foreclosed on, or accepted deed for, 514 of that number. Thus, one out of every 20 mortgage-burdened farmers lost any equity which they had in their farms. Several companies foreclosed on more than 10 per cent of their mortgages, and one company foreclosed on 32 mortgages out of 80.

It is expected that higher prices of agricultural products, together with facilities for the refinancing of farm mortgage through the Federal Land Bank and also the foreclosure-restraining powers granted the court by the Best Bill enacted into law by the last Ohio legislature, will aid in reducing the number of farm foreclosures in 1933. Whether insurance companies will adjust their farm loan policies to meet the new terms of the Federal Land Bank has as yet been unannounced.

OHIO WHEAT ACREAGE AND PRODUCTION

J. I. FALCONER

The data in the accompanying table, compiled by the Bureau of Agricultural Economics of the U. S. Department of Agriculture in cooperation with the Rural Economics Department of the Ohio Agricultural Experiment Station, represent the basis which will be used by the Agricultural Adjustment Administration in making the county allotment of wheat acreage and production.

TABLE 1.—All Wheat—5-year Average Annual Acreage and Production, 1928-1932

County	Farms growing wheat, 1929	Acres seeded	Av. yield per seeded acre	Acres harvested	Av. yield per harvested acre	Total production
	No.	*No.*	*Bu.*	*No.*	*Bu.*	*Bu.*
1. Wayne	2,916	51,800	20.1	48,500	21.5	1,043,400
2. Pickaway	1,309	67,600	14.4	53,000	18.4	976,800
3. Seneca	2,204	49,300	18.3	40,200	22.5	903,800
4. Hancock	1,957	43,200	18.0	33,400	23.3	777,200
5. Preble	1,623	41,900	17.8	35,000	21.3	743,900
6. Fairfield	1,991	47,300	15.1	39,900	17.9	714,800
7. Sandusky	1,723	36,000	19.1	30,000	22.9	686,800
8. Darke	2,562	41,800	16.3	30,800	22.1	681,300
9. Wood	2,230	41,900	16.0	28,700	23.4	672,300
10. Ross	971	47,600	14.1	36,400	18.4	671,500
11. Miami	1,645	37,600	17.0	28,100	22.8	639,900
12. Butler	1,281	40,200	15.2	33,400	18.3	612,500
13. Huron	1,680	30,500	19.3	27,700	21.3	588,800
14. Clinton	964	36,600	15.9	28,900	20.1	581,600
15. Richland	2,008	31,500	18.3	28,600	20.2	577,200
16. Wyandot	1,399	32,500	17.1	25,000	22.2	554,600
17. Franklin	1,182	33,000	16.7	26,400	20.9	552,300
18. Montgomery	1,862	31,800	17.1	23,800	22.9	544,100
19. Henry	1,653	30,300	18.0	23,600	23.1	544,000
20. Crawford	1,699	30,400	17.9	26,700	20.4	543,700
21. Fulton	1,755	30,000	17.9	22,900	23.5	537,900
22. Stark	2,377	28,600	18.8	26,900	20.0	536,700
23. Putnam	1,704	34,600	15.3	22,000	24.1	529,700
24. Knox	1,794	31,100	16.8	26,200	20.0	523,800
25. Clark	974	30,000	17.1	22,800	22.5	512,000
26. Ashland	1,577	26,500	19.3	25,200	20.3	511,000
27. Greene	942	30,600	16.7	23,400	21.8	510,900
28. Licking	1,647	31,900	15.7	25,600	19.6	500,800
29. Highland	1,252	36,000	13.7	28,200	17.5	493,700
30. Holmes	1,821	27,200	17.1	24,500	18.9	464,200
31. Williams	1,701	26,500	17.4	19,200	24.0	460,200
32. Mercer	1,470	29,200	15.2	19,700	22.5	442,600
33. Fayette	575	27,900	15.3	21,100	20.3	428,200
34. Champaign	810	25,100	17.0	18,300	23.3	425,600
35. Madison	597	24,800	16.7	19,000	21.8	414,900
36. Auglaize	1,306	27,300	14.8	16,800	24.1	404,900
37. Marion	924	22,700	17.1	16,900	23.0	388,300
38. Warren	942	23,600	16.4	19,500	19.9	388,100
39. Medina	1,732	19,800	19.1	18,300	20.6	377,500
40. Defiance	1,233	25,600	14.6	17,200	21.7	373,000

TABLE 1.—All Wheat—5-year Average Annual Acreage and Production, 1928-1932—Continued

	County	Farms growing wheat, 1929	Acres seeded	Av. yield per seeded acre	Acres harvested	Av. yield per harvested acre	Total production
		No.	*No.*	*Bu.*	*No.*	*Bu.*	*Bu.*
41.	Delaware	1,073	19,900	17.6	15,800	22.1	349,900
42.	Tuscarawas	1,682	19,100	18.0	17,400	19.7	343,500
43.	Lorain	1,618	16,900	20.0	16,300	20.7	337,500
44.	Shelby	1,073	19,300	17.3	14,100	23.6	333,400
45.	Morrow	1,290	18,300	17.2	15,300	20.6	314,700
46.	Erie	882	16,300	19.0	14,300	21.6	309,500
47.	Hardin	891	18,600	16.5	12,900	23.8	306,500
48.	Coshocton	1,480	19,200	15.8	16,800	18.0	303,000
49.	Allen	1,028	18,400	16.4	12,600	23.9	301,300
50.	Ottawa	1,096	16,500	18.1	12,000	24.9	299,100
51.	Columbiana	1,918	16,400	17.5	15,400	18.7	287,800
52.	Lucas	877	13,800	20.7	11,300	25.3	285,800
53.	Union	665	16,800	14.0	10,300	22.9	235,900
54.	Logan	560	13,000	16.6	8,900	24.3	216,200
55.	Portage	1,307	11,100	19.0	10,300	20.5	211,400
56.	Perry	938	13,500	15.1	11,900	17.1	203,200
57.	Muskingum	1,197	13,800	14.5	11,900	16.9	200,600
58.	Summit	791	8,900	19.7	8,200	21.4	175,200
59.	Van Wert	529	10,000	17.2	7,400	23.3	172,300
60.	Paulding	555	12,900	13.2	7,900	21.6	170,900
61.	Mahoning	1,225	9,000	18.7	8,400	20.1	168,600
62.	Carroll	1,183	10,600	15.7	9,900	16.8	165,900
63.	Adams	761	14,000	11.2	10,800	14.5	157,100
64.	Washington	949	7,500	16.3	7,200	17.0	122,600
65.	Brown	559	10,200	11.7	8,200	14.5	119,100
66.	Hamilton	417	7,500	15.2	6,000	19.2	113,900
67.	Trumbull	822	5,400	18.3	5,000	19.7	98,700
68.	Guernsey	692	6,100	15.6	5,700	16.6	94,900
69.	Belmont	637	5,500	16.8	5,100	18.1	92,200
70.	Clermont	308	6,600	13.9	5,700	16.1	92,000
71.	Harrison	621	5,400	15.3	4,600	17.9	82,500
72.	Morgan	610	5,300	15.5	4,700	17.5	82,200
73.	Jefferson	635	5,700	14.4	4,700	17.4	81,800
74.	Meigs	553	5,200	15.6	4,700	17.3	81,200
75.	Hocking	440	6,300	12.7	5,400	14.8	79,800
76.	Pike	209	6,500	11.9	5,200	14.9	77,600
77.	Ashtabula	639	4,100	18.1	3,600	20.7	74,400
78.	Monroe	696	4,800	15.1	4,500	16.1	72,300
79.	Scioto	300	4,800	14.6	4,100	17.1	70,200
80.	Gallia	390	5,200	13.0	4,300	15.7	67,400
81.	Noble	542	3,700	14.7	3,500	15.5	54,400
82.	Athens	333	3,700	14.3	3,100	17.1	52,900
83.	Geauga	430	2,800	18.4	2,300	22.3	51,400
84.	Jackson	282	3,900	11.6	3,100	14.5	45,100
85.	Lake	154	1,500	18.7	1,300	21.6	28,100
86.	Cuyahoga	221	1,300	19.0	1,200	20.6	24,700
87.	Vinton	119	1,800	13.7	1,700	14.5	24,600
88.	Lawrence	50	800	15.2	700	17.4	12,200
	State	98,219	1,830,000	16.7	1,468,000	20.8	30,480,000

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

The rising price level which became evident during May continued into July. The month of June showed no rise in Ohio from prices over May, but July continued the advance, due mainly to rising grain prices. The farm price of wheat passed the dollar mark during threshing time. The sharp rise in grain prices was probably due more to the prospective short crop of all grains than to the general rise in the price level. The Ohio wheat crop gave a normal yield, but that for the nation as a whole was 40 per cent below normal. A shortage of feed crops for the coming year seems probable.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	.....	100	100	104	100	105	100
1914	99	100	101	102	102	102	105	107
1915	102	101	106	100	103	107	106	110
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	141	232	156	139	169	96	154	147
1929	139	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	128	130
1931	107	207	129	80	120	82	89	93
1932	95	178	110	57	92	70	63	67
1931								
January	114	212	137	94	133	.....	104	115
February	112	215	136	90	.....	.....	96	85
March	111	219	134	91	.....	82	98	104
April	109	215	133	91	119	.....	102	97
May	107	211	130	86	.....	.....	96	90
June	105	207	129	80	.....	.....	92	93
July	105	207	128	79	115	.....	84	86
August	105	207	127	75	.....	.....	86	90
September	104	205	124	72	.....	.....	82	87
October	103	199	122	68	116	.....	77	86
November	102	196	120	71	.....	.....	79	93
December	100	194	119	66	.....	.....	72	88
1932								
January	98	191	115	63	100	.....	69	81
February	97	189	114	60	.....	.....	64	68
March	96	189	112	61	.....	70	64	67
April	95	183	111	59	94	.....	64	65
May	94	177	109	56	.....	.....	61	63
June	93	174	108	52	.....	.....	59	61
July	94	171	107	57	90	.....	63	67
August	95	172	107	59	.....	.....	66	73
September	95	177	106	59	.....	.....	64	67
October	94	177	105	56	84	.....	61	68
November	93	171	104	54	.....	.....	61	56
December	91	170	103	52	.....	.....	60	96
1933								
January	89	164	102	51	75	.....	55	62
February	87	164	101	49	.....	.....	53	61
March	88	163	100	50	.....	59	53	54
April	88	165	101	53	70	.....	59	60
May	92	169	102	62	.....	.....	71	72
June	95	.....	103	64	73	.....	70	82

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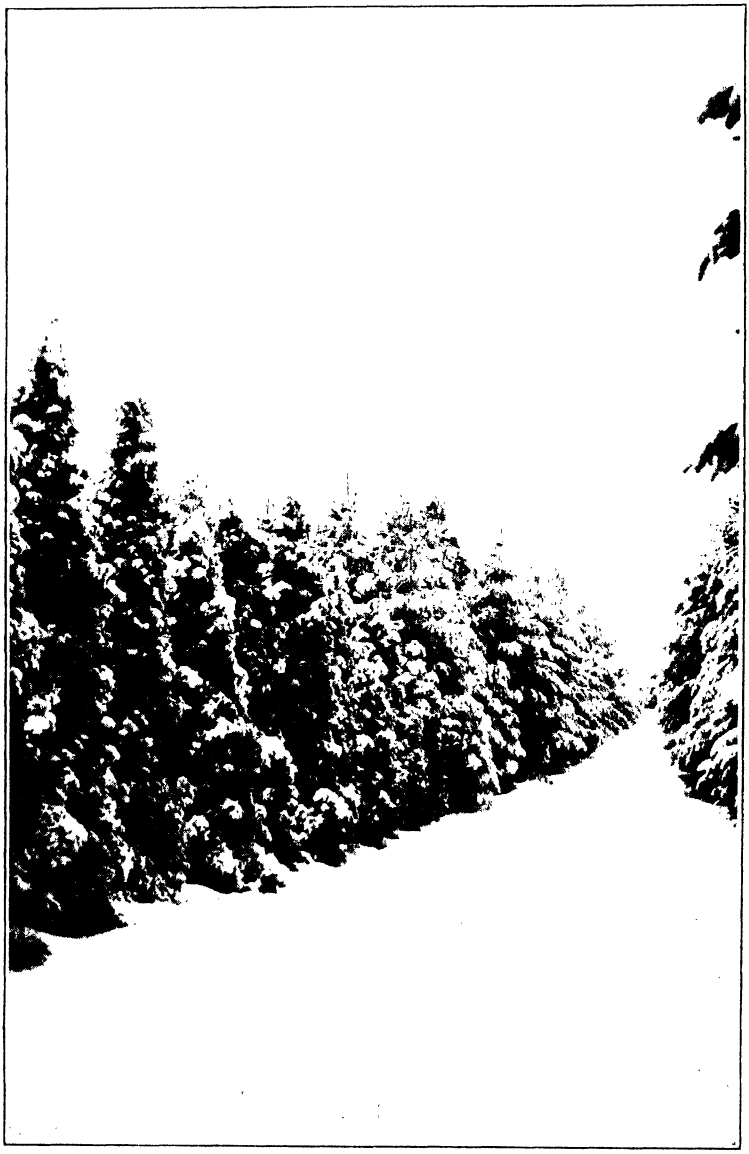

Winter at the Ohio Experiment Station

FERTILIZING PERMANENT PASTURE

F. A. WELTON

To determine the effect of different kinds and combinations of fertilizers and of limestone applied to an old pasture, an experiment was started in the spring of 1924 on the Fry farm, where the soil is a Wooster silt loam with good natural, but no artificial, drainage. The land had once been cropped, but for many years prior to the starting of this experiment it had been in permanent pasture consisting chiefly of Kentucky blue grass with a sprinkling of white clover. The pasture was neither extremely poor nor extra good; it was fair and comparatively free from weeds.

Ten plots, each containing one-twentieth acre (136 feet 2 inches by 16 feet), were laid off with 4-foot alleys between, the first and every third plot thereafter being left without any treatment to serve as checks. With the exception of the nitrogen which was applied annually, the fertilizer and the limestone were applied once in 4 years, the first application being made April 21, 1924, and the second, April 16, 1928. Throughout the experiment, the grass was mowed with a lawn mower and the green and dry weights determined. During the first two seasons, four well distributed square-yard areas only on each plot were mowed, these being inclosed by woven wire fence. This method, however, proved unsatisfactory; hence, beginning in 1926, the whole plots were mowed, the entire group being fenced off and thus protected from the cattle in the main field. The mowings were made at irregular intervals but with greater frequency in the fore part than in the latter part of the season; the clippings up to August 1 were made about 2 weeks apart. The yield in dry weight was in all cases calculated on the basis of 72.9 per cent moisture, this percentage being the average of 677 determinations made at approximately 45° C.

The treatments and the yields per acre, as corrected by the checks, were as shown in Table 1.

The rather inconsistent yields obtained in the first years of the test from the use of either superphosphate or limestone alone were probably due to the fact that, for some unknown reason, the first two checks, particularly the first one, often yielded more than the treated plots. For this reason it is hardly safe to conclude, as the yields in some of the years indicate, that the use of these materials separately was not beneficial. From the 7-year average yield it may be noted that a gain of 313 pounds per acre was obtained from the use of the superphosphate-limestone combination. Fifty-five pounds of muriate of potash per acre added to this combination increased the yield only 68 pounds—not enough to pay for the cost of the material. Sulfate of ammonia added to the three did not materially increase the yield, but, when used with superphosphate, the gain was practically the same as that obtained from the superphosphate-limestone combination.

The growth made after the first of August was, on the average, approximately 20 per cent of the total for the season. In some years favorable for fall growth, it ran somewhat higher, the maximum obtained being 30 per cent of the total. In two seasons, 1925 and 1930, mowings were discontinued in July. In 1925 they were lost on account of cattle breaking into the small inclosures. In 1930 the excessive heat and drouth not only resulted in no growth of grass but the conditions were so extreme that much of the grass died and the experiment, therefore, was discontinued. The lawn mower method of mowing, however, was probably a contributing factor, for the grass survived in the closely-pastured, adjoining field as well as in the continuously unclipped 4-foot alleys between the plots.

TABLE 1.—Topdressing Pastures with Fertilizers

Plot No.	Treatment		Pounds dry matter per acre								
			Fry Farm								Hindman Farm
	Kind of material	Lb. per acre	1924	1925	1926	1927	1928	1929	1930	7-yr. av.	1925
1-4-7-10	Nothing	......	904	1374	1075	1594	2586	2012	746	1470	575
2	Superphosphate (20%)	400	747	1466	936	1644	3194	2295	814	1585	569
3	Limestone	2000	941	1085	1133	1623	2589	2024	751	1449	680
5	Superphosphate (20%) Limestone	400 2000	864	1818	1311	1808	3501	2417	765	1783	639
6	Superphosphate (20%) Limestone Muriate of potash	400 2000 55	1222	1914	1302	1830	3652	2279	756	1851	788
8	Superphosphate (20%) Limestone Muriate of potash Sulfate of ammonia (annually)	400 2000 55 100	1484	2034	1540	1810	3292	2148	805	1873	799
9	Superphosphate (20%) Sulfate of ammonia (annually)	400 100	1546	1397	1312	1771	3150	2479	937	1799	730

Why clipping, even though it were close, would be more injurious than grazing is difficult to explain. Possibly lawn mowing results in uniformly closer topping than does grazing throughout the pasturing period. Close mowing, therefore, might affect adversely and to an unusual degree the life of the plants, particularly in the early part of the season when growth is most luxuriant and the storage of organic food reserves[1] and root growth[2] is going on most rapidly.

If the lawn mower method of harvesting is injurious to the growth of grass, then it is probable that the yields obtained represent a somewhat lighter growth than would have developed under pasturing conditions.

[1]Aldous, A. E. Relation of Organic Food Reserves to the Growth of Some Kansas Pasture Plants. Jour. Am. Soc. Agron. 22: 385-392. 1930.

[2]Sprague, Howard B. Root Development of Grasses and its Relation to Soil Conditions. Abstracts of Papers, 25th An. Meeting, Am. Soc. Agron., Nov. 17-18, 1932.

For chemical analysis composite samples were made up from certain plots in 1927, 1928, and 1929. In these were representative clippings from each mowing during the season, the quantity used from each being proportionate to the yield. On these samples were determined the percentages of nitrogen, phosphorus, potassium, and calcium. The results obtained, tabulated in Table 2, show that the use of superphosphate increased the percentage of nitrogen, phosphorus, and calcium. Superphosphate and limestone combined increased still more and quite markedly the percentage of calcium. Taken in connection with the yields, superphosphate increased the pounds per acre of nitrogen, phosphorus, potassium, and calcium 34, 26, 2, and 23 per cent, respectively. The superphosphate-limestone combination increased the same constituents 42, 40, 13, and 78 per cent, respectively. The addition of muriate of potash and sulfate of ammonia made no further material increase.

TABLE 2.—Composition of Pasture Grass

Treatment		Per cent				Pounds per acre			
Kind of material	Pounds per acre	N	P	K	Ca	N	P	K	Ca
Nothing	....	2.87	0.343	2.64	0.669	42.2	5.0	38.8	9.8
Superphosphate (20%)	400	3.58	0.397	2.50	0.765	56.7	6.3	39.6	12.1
Superphosphate (20%) Limestone	400 2000	3.37	0.393	2.47	0.981	60.1	7.0	44.0	17.5
Superphosphate (20%) Limestone Muriate of potash	400 2000 55	2.98	0.403	2.49	0.938	55.2	7.5	46.1	17.4
Superphosphate (20%) Limestone Muriate of potash Sulfate of ammonia	400 2000 55 100	3.14	0.373	2.07	0.846	58.8	7.0	38.8	15.8

A second pasture experiment in which the size and treatment of plots were the same as in the one already described was started the same year, 1924, on the Hindman farm, which represents the same type of soil with a lower level of fertility. This area was not tile drained, but it had good natural drainage. The land had been cropped to corn and wheat a few times in its history but at the time of the starting of the test it had been in pasture about 7 years. The stand of grass was thin, and in places moss and sorrel predominated; yarrow and other weeds were generally distributed over the entire area. In 1924, the plots were neither mowed nor pastured. Early in 1925 all the plots were mowed with a mowing machine in order to rid them of the weeds and other growth made the preceding year. During the summer, they were mowed three times with a lawn mower. The total dry matter obtained in the three cuttings is shown in Table 1. The most outstanding result in this test was the increase in growth of white clover, which was especially noticeable on all the plots to which superphosphate had been added. In the fall of 1925, abandonment of the test was made necessary by reason of the fact that hogs were unexpectedly turned in an adjoining field and broke into the pasture plots and ruined the sod.

For some unknown reason, they displayed a fine discretion for the fertilized plots, the view to the right in Figure 1 being typical of the way in which they avoided all the checks.

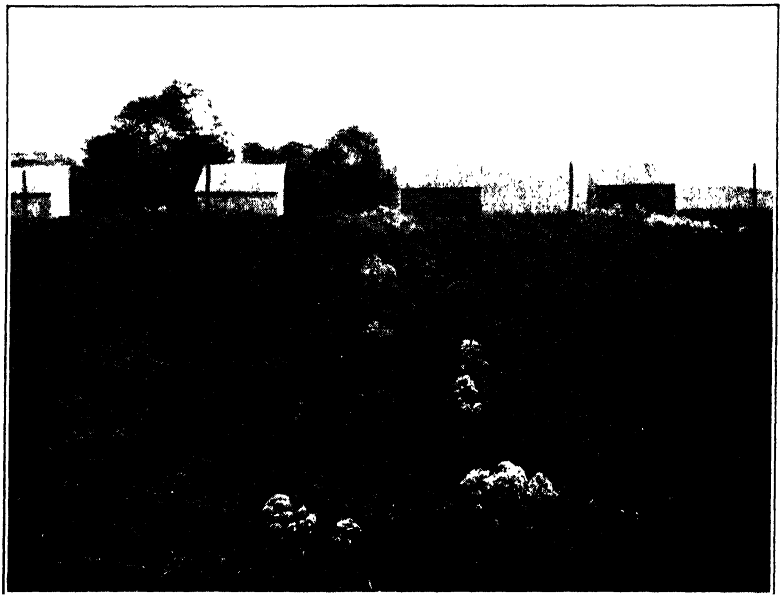

Fig. 1.—Fertilized section (left) torn up by hogs; unfertilized (right) was left unmolested

SUMMARY

An old but not virgin pasture consisting chiefly of Kentucky blue grass and some white clover and located on Wooster silt loam was topdressed with limestone and chemical fertilizers April 21, 1924, and again on April 16, 1928. The grass was mowed with a lawn mower and the dry weight determined. As an average of 7 years, limestone and superphosphate combined increased the yield of dry matter 21 per cent. The addition of muriate of potash to the limestone-superphosphate combination made a further gain of less than 4 per cent, and the addition to the same combination of both muriate of potash and sulfate of ammonia resulted in a gain of 5 per cent. Probably the gains secured were less than would have been obtained under pasture management for there was some evidence that the lawn mower method of harvesting was a contributing factor in the death of much of the grass in the drouth year of 1930.

Superphosphate alone and the limestone-superphosphate combination increased the chemical constituents of the grass.

In a second test located on a similar soil but representing a lower level of fertility, the use of the superphosphate-limestone combination resulted in the coming in of considerable white clover the second year after application.

CORN-AND-COB MEAL VERSUS SHELLED CORN FOR FATTENING CALVES

PAUL GERLAUGH AND H. W. ROGERS

Two lots of choice Hereford steer calves were started on test[1] in November, 1932, to determine the relative value of a bushel of ear corn when fed as corn-and-cob meal and when fed as shelled corn. The same amount of protein supplement was fed per calf in both lots; the hay was full fed. No silage was used in either ration.

The calves in Lot 2 (on shelled corn) seemed to be a fatter lot of calves than those fed corn-and-cob meal from April to the close of the test, although the calves in Lot 1 made more rapid gains from the start of the test.

TABLE 1.—Corn-and-Cob Meal Versus Shelled Corn for Fattening Calves

	Lot 1 Corn-and-cob meal	Lot 2 Shelled corn
Cost in feed lot	$ 7.25	$ 7.25
Average weight, November 23, Lb.	375	377
Average weight, August 17, Lb.	972	921
Average daily gain, Lb.	2.24	2.04
Average daily ration, Lb.:		
Corn-and-cob meal	12.4	....
Shelled corn	....	10.5
Protein supplement*	2.0	2.0
Mixed hay	3.1	3.2
Cost per cwt. of gain	$ 4.41	$ 4.91
Pork credit per calf, Lb.	35.00	72.00
Gain on calves per bushel of corn fed, Lb.	12.66	10.88
Gain on pigs following, per bushel corn fed to calves, Lb.	0.74	1.44
Necessary selling price, feed-lot weight and pork credited	$ 5.36	$ 5.58
Market appraisals:		
Buffalo	$ 6.85	$ 6.85
Cleveland	$ 6.75	$ 6.75
Pittsburgh	$ 6.50	$ 6.75
State Fair Auction selling price, August 30	$ 6.85	$ 6.85
Selling price figured to feed-lot weight	$ 6.60	$ 6.60
Profit per calf, pork credited	$ 12.05	$ 9.62
Returns per bushel of corn (no processing charge)	$ 0.645	$ 0.568

**Protein Supplement:* Equal parts of linseed meal, cottonseed meal, [illegible]

Feed Prices: Corn, $0.25 per bu. to April 12 and $0.50 per bu. April 12 to August 17; protein supplement, $20.00 per ton; hay, $6.00 per ton; hogs, $4.00 per cwt.

Prior to the start of the test the calves had a very severe attack of shipping fever. Six died from the trouble, and most of those remaining had an attack varying from mild to severe. An attempt was made to divide the calves for the feeding test with this handicap in mind. During the month of April three calves in Lot 2 developed a severe illness. All recovered but lost weight for a short period. The cause of this latter trouble is not definitely known; however, it was not thought to be due to the feeding of shelled corn. Due to these unavoidable handicaps in health, it is thought that the results are less accurate than hoped for but that they point in the correct direction. The test

[1]The test was conducted at the Madison County Experiment Farm, where H. W. Rogers is superintendent.

will be repeated. No attempt is made to show costs of either shelling or grinding. The returns are quoted on the basis of ear corn. Shelling tests showed that 70 pounds of ears produced 56 pounds of shelled corn.

Pigs following the calves fed corn-and-cob meal made 0.74 pound gain per bushel of corn fed to the calves; whereas pigs following the shelled-corn-fed calves gained 1.44 pounds per bushel of corn fed to the calves.

The cattle were sold at the State Fair auction. A deduction of $0.25 per hundredweight was made from this selling price to cover trucking, shrinkage, and selling expense.

A SYSTEM OF PRUNING PEACH TREES DESIGNED TO REGULATE THE HEIGHT AND RENEW THE TOPS

J. S. SHOEMAKER

There has been a real need for a definite system of peach pruning which will not only regulate the height of the mature trees desirably but will also provide a means of renewing their tops each year so that the fruiting area will be well distributed and adequate for a good crop. Furthermore, there has been a need for a system which could be easily understood by the pruning crew so that different men would make the principal pruning cuts more uniformly. As a result of recent developments it is now possible to outline a system which will comply with these requirements.

Pruning practices which have prevailed on mature trees in the past may be classified as follows (the open center being universally adopted): (1) Practically shearing the top portion of the trees. Peach trees pruned in this manner may still be seen in some orchards in northern Ohio. The fruiting area is greatly reduced, largely because of a fear of tree exhaustion, and high yield of fruit per tree is sacrificed for size of fruit. This pruning practice is out-of-date, since it preceded the use of fertilizer, fruit thinning, and other advances in peach culture. (2) Practically neglecting pruning until the trees become so tall that something has to be done. This practice has not always been followed due to neglect, but frequently it has been a purposeful procedure. Often, after the trees have grown out-of-bounds, they have been "dehorned" or "deheaded". A very weak framework has resulted on the more or less neglected trees, and the dense growth promoted by deheading is undesirable. (3) Waiting until comparatively late or until bloom to observe the amount of bud killing and then pruning lightly or severely in accordance with the prospects for a crop. When light pruning has been practiced, the pruning problem becomes more difficult the next year; in fact, there has been no good means of bringing the trees back to a desirable form and condition. On the other hand, when abnormally severe pruning has been practiced, the vigorous growth associated with crop failure has usually resulted in poor tree form and condition. (4) Pruning so that the smaller branches are cut out at crotches comparatively high in the trees and the largest ones left. It stands to reason that, if the prevailing practice is to cut out the smaller branches and leave the larger ones

unchecked in the tops of the trees, the trees will become taller and taller each year. (5) Attempting to keep the trees within bounds by heading back in the tops but with little, if any, systematic effort toward providing renewal wood.

The pruning of mature peach trees, because of the vigor of growth habit and the nature of the fruiting habit, may well be, on the whole, heavier than is the case with the other tree fruits. The system presented here is remarkably simple.

Because this article is necessarily brief, it must first be assumed that the young trees have been reasonably well trained and pruned and maintained in thrifty condition by good cultural practices. It is to be recalled that with young trees severe pruning may decrease the size of the tree so that yield is reduced without compensating gain in size of fruit. A "bowl-shaped" rather than a "vase-shaped" tree is most desirable. The vase-shaped tree is likely to be narrow and lacking in amount of fruiting surface, particularly in the lower part of the tree. The bowl-shaped tree possesses a well-rounded base, a wide-spreading top, and good potential fruiting area in both the lower and upper parts. It is in the lower one-third to one-half that young peach trees bear most of the fruits of the first crops. Light to moderate directive and corrective pruning, both thinning out and heading back, is best for young peach trees.

Fig. 1.—The renewal height is at a point between 8 and 9 feet above the ground. A cut was made in 1932, removing the largest branch at the crotch. The branch extending to the left, now the largest branch, is to be removed in 1933. Note the central shoot, which will become the largest for the next year. New replacement shoots will arise near the cut.

Many factors, such as planting distance and soil fertility, determine the most desirable height at which peach trees should be restricted for renewal purposes. Controlling the renewal height between 8 and 9 feet on mature trees is probably a good guide for average conditions.

The essence of this pruning development is that, at 8 to 9 feet high in the trees, the largest branch at each crotch should be removed in order to control

the renewal height of the top. The smaller branches at each of these crotches furnish adequate and suitable wood in the top. If there are two of them, both may be left for a year and the one which becomes largest during the growing season should be removed at the next year's pruning. By this time, a new one should be developing to make possible the continuation of the renewal process. The development of replacement branches at the desired renewal height is due in part to the stimulation at the pruning cut and is associated with the natural, vigorous growth habit of the peach tree. After the cuts become too numerous at a given crotch, another one, often somewhat lower than the first, may be utilized for the renewal point. No claim is made that this system of renewal pruning is adapted to apple, pear, cherry, or plum trees.

It will be noted that systematic renewal pruning gives little consideration to light or severe treatment in accordance with crop prospects. However, it does provide some opportunity in this respect because (a) usable crotches occur at different heights, (b) more than one of the smaller branches occur at most crotches, and (c) the branches which extend from the renewal points to the extreme top of the tree may be modified by degrees of heading back.

Systematic renewal pruning may be practiced with equally satisfactory results in the different months throughout the dormant season; this is a factor of definite importance to the operator of a large orchard who must distribute the pruning work over a comparatively long period.

The discussion has been practically limited to consideration of procedure for the top portion of the trees; that is, the place where the chief pruning of mature trees is involved. The renewal system of pruning affects the branches at the sides of the tree to the extent that many of them extend to the perimeter. However, the renewal system is not so well adapted to controlling the spread as to the height. Thinning out and heading back of branches at the sides of the trees should augment the renewal pruning. As far as the numerous, small, detailed cuts in peach pruning are concerned, they should be made up to the point where thinning would become too expensive. A test at Wooster has shown that it took more time to make the small, "miscellaneous" cuts of secondary importance than it did to make those in the renewal process or principal pruning.

The open-center type of tree prevails in peach pruning practice. The renewal system of pruning permits the proper retaining of a good open tree with more branches in the top of the center than has been the case with an extremely open-centered tree. Removing the largest branch at the crotches at the desired renewal height promotes a vigorous growth but not an excessive length of growth.

The idea for the renewal system of pruning is a development from work conducted in Indiana. The writer first became impressed with its merits while attending a meeting of the Kentucky Horticultural Society where the operator of a very large peach orchard gave the system enthusiastic commendation. Although our experience with the system is comparatively limited, it has seemed desirable to bring it to the general attention of Ohio peach growers at this time because it seems to provide a distinct advance in peach pruning and one well worthy of widespread consideration.

SOME EFFECTS OF BORDEAUX MIXTURE ON TRANSPIRATION

J. D. WILSON AND H. A. RUNNELS

The influence which bordeaux mixture exerts on the transpiration rate of a plant varies widely with the species, with the different environmental conditions, and with the time of day. Frequent observations made by the authors during the past 4 years (1, 2) indicate that drouth injury, for instance, is greatly aggravated on certain species by the presence of bordeaux mixture on the leaves. Marginal burning of the leaves and stunting, two symptoms which are characteristic of the combined bordeaux-drouth injury (1, 2), may be produced almost at will by subjecting certain plant species which have been sprayed with bordeaux mixture to drouth conditions.

A number of plants, such as Coleus, tomato, cucumber, and potato, have been used in a variety of studies on the influence of bordeaux mixture on the transpiration rate. Coleus has proven to be the best of these because of the wide variations which occur in its rate of water loss upon the application of bordeaux mixture to the leaves. Also, the fact that all, or nearly all, of its stomata are on the lower side of the leaf makes it a good plant for use in studying the relative influence of a bordeaux film on cuticular, as distinct from stomatal, transpiration.

In an experiment, which was repeated several times between April 15 and May 15, 1933, bordeaux mixture was applied by means of a soft brush to both sides of the leaves of one group of Coleus plants growing in one-half gallon metal containers, to the lower side only of a second group, and to the upper side only of a third. A fourth lot of comparable plants was left untreated and included in the experiment as a check (See Figure 1). All of the plants, together with black and white atmometers (3), were then placed on a rotating table. Plants and atmometers were weighed at regular intervals, sufficient water being added each time to bring the plant containers back to their original weight. Observations on the stomatal condition were made at hourly intervals on certain days.

The usual relationships between the transpiration rate and variations in stomatal aperture were observed for the untreated plants. The stomata of the plants in all four groups were found to behave in a very similar manner, especially in regard to time of opening and closing. Since many of the stomata on the leaves which had bordeaux mixture on the lower side could not be clearly seen, it is possible that the total maximum area of stomatal aperture was not as great on these plants as on the untreated ones. However, the transpiration rates in each of the four groups of plants varied widely during certain periods of the day and it is with these variations that we are here concerned.

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1. Wilson, J. D. and H. A. Runnels. Bordeaux mixture as a factor increasing drouth injury. Phytopath. 21: 129-138. 1931.
2. Wilson, J. D. and H. A. Runnels. Some detrimental effects of spraying tomatoes with bordeaux mixture. Ohio Agr. Exp. Sta. Bimo. Bull. 18: 4-15. 1933.
3. Livingston, B. E. A radio-atmometer for comparing light intensities. Plant World 14: 96-99. 1911.

Previous workers have mentioned the fact that the influence of bordeaux mixture in increasing the transpiration rate is much greater during the night than during the day (4, 5). This variation has been found to occur in the present investigation, as shown by the data in the first section of Table 1.

TABLE 1.—Effect of Bordeaux Mixture on the Water Loss from Coleus Plants

	7 A. M. to 10 A. M.	10 A. M. to 1 P. M.	1 P. M. to 4 P. M.	4 P. M. to 7 P. M.	7 A. M. to 7 P. M.	7 P. M. to 7 A. M.	7 A. M. to 7 A. M.	3-hr. av. 7 P. M. to 7 A. M.
Water losses from Coleus plants for different periods of the day. Treatment, 3-4½-50 bordeaux mixture.								
	Gm.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
No treatment	34.9	53.2	48.8	22.4	159.2	14.1	173.3	3.53
Both sides of leaves	36.0	51.4	46.7	34.2	167.9	66.4	234.3	16.60
Upper side only	36.3	53.6	47.9	27.2	165.2	32.2	197.4	8.05
Lower side only	34.4	49.4	43.8	30.3	158.1	55.9	214.0	13.98
Water losses from bordeaux-treated plants of above section stated in terms of percentage of loss of untreated plants.								
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	
Both sides of leaves	103	97	96	153	105	471	135	....
Upper side only	104	101	98	121	104	228	114	....
Lower side only	98	93	90	135	99	396	123	....
Relative transpiration of untreated and treated plants at different periods of the day. Corrected black atmometer values used as the divisor.								
Check	7.93	9.17	9.21	4.67	7.83	1.40	5.71	....
Both sides	8.18	8.86	8.81	7.13	8.27	6.57	7.71	....
Upper side only	8.25	9.24	9.21	5.67	8.12	3.19	6.49	....
Lower side only	7.81	8.51	8.26	6.31	7.79	5.53	7.01	....

During the period from 7 P. M. to 7 A. M. the average rate of water loss from plants having bordeaux mixture on both sides of their leaves was 4.7 times as great as that from untreated plants. (See second section of Table 1). Corresponding values for plants having only the lower or upper side of their leaves treated were 4.0 and 2.3, respectively. Hourly weighings made on certain days indicated that, as the forenoon advanced, all treated plants continued to lose water more rapidly than the untreated ones until about 9 A. M. At this time the stomata on all four groups of plants were well open and the transpiration rate of the untreated plants had become nearly as great as that of the treated groups. By 11 A. M. the two groups of plants with bordeaux mixture on the lower side of their leaves were losing water less rapidly than the untreated plants. The plants with a bordeaux film on the upper side of their leaves only maintained a transpiration rate equal to, or slightly above, that of the untreated plants until 1 P. M. For the period from 1 to 2 P. M. the rate of all three treatments was below that of the untreated plants. The stomata on all the plants began to close between 1 and 2 P. M., and by 4 P. M. many of them were closed. The rate of water loss from the untreated plants then began to fall below that of the treated groups. Between 4 and 7 P. M. this discrepancy in rates became rapidly greater with the result that, for this period, plants treated on both sides of the leaves, lower side only, and upper

4. Duggar, B. M. and W. W. Bonns. The effect of bordeaux mixture on the rate of transpiration. Ann. Mo. Bot. Gard. 5: 153-176. 1918.

5. Martin, W. H. and E. S. Clark. Influence of bordeaux mixture on transpiration. N. J. Agr. Exp. Sta. An. Rept. 50, 249-255. 1929.

side only lost 53, 35, and 21 per cent more water, respectively, than did the untreated plants. Stomatal closure was observed to be complete by 6 P. M. on all plants. These data indicate that little or no relationship exists between the stomatal condition and the degree of acceleration in the transpiration rate brought about by the presence of bordeaux mixture on the leaves of Coleus plants.

Fig. 1.—Representative Coleus plants from each of the four groups used in this study. Numbering from left to right the treatments were: 1, no treatment; 2, bordeaux mixture on upper side of leaves only; 3, on lower side only; and 4, on both sides.

The appearance of a representative plant from each of the four groups described above 24 hours after one of the rotating-table experiments had been discontinued is illustrated in Figure 1. The untreated plant on the extreme left is still turgid and normal in appearance. Progressing toward the right, the next plant has bordeaux on the upper sides of its leaves only, and, although it had probably lost 15 per cent more water than the untreated plant during the preceding 24-hour period, it is also still turgid. The next plant (the third from the left), with bordeaux on the lower sides of its leaves only and with a water loss possibly exceeding that of the untreated plant by 25 per cent, exhibits a flaccidity of leaf blades and petioles. The plant on the extreme right, with bordeaux on both sides of its leaves, has lost water most rapidly and even the main stem has lost its turgidity and upright position. The leaf margins are dry and brittle and would show permanent injury even if a plentiful supply of water were added to the soil at once.

The daily transpiration curve of a plant treated with bordeaux mixture on both sides of its leaves coincides much more closely with the daily evaporation curve of a black atmometer than does that of an untreated plant. This is illustrated by comparing the values for relative transpiration (6) of treated and untreated plants given in the third section of Table 1. These values were 1.4 and 6.6 for the night period for untreated and treated plants, respectively; whereas, they were 7.8 and 8.3 for the day period from 7 A. M. to 7 P. M. and 9.2 and 8.8 for the period from 10 A. M. to 4 P. M. only.

6. Livingston, B. E. Relative transpiration in cacti. Plant World 10: 110-114. 1907.

Thus, it appears that the accelerating influence of a bordeaux film on the transpiration rate of a plant is due chiefly to a change in the rate of cuticular transpiration; whereas stomatal transpiration is more likely to be retarded than increased. The two groups of plants with bordeaux on the lower side of their leaves showed the greatest acceleration of the transpiration rate during the night period when the stomata were closed; whereas, the untreated plants showed a slightly greater loss during the day period when the stomata were fully open. The fact that those plants which were treated only on the upper side of the leaves maintained a transpiration rate throughout the day period which was practically equal to that of the untreated plants suggests that the presence of the spray material over the stomata must act to retard slightly the water loss during mid-day or that the cooling effect of the material is great enough more than to counterbalance any accelerating effect.

It has been shown by various workers that bordeaux mixture does exert a cooling effect on leaves to which it is applied (7). This should in turn result in a reduction in the transpiration rate of these leaves. An analysis of the daily transpiration curves of the untreated plants used in this experiment and those of the plants treated on the upper side of their leaves only shows that the former lost 0.1 gm. per hour per plant less than did the latter from 10 A. M. to 1 P. M.; whereas they lost 1.5 gm. less per hour during the night period. Therefore, it may be considered that the total reduction in the transpiration rate brought about by lowering of the leaf temperature was 1.5 minus 0.1, or 1.4, gm. per hour per plant. This amounted to 8 per cent of the total hourly loss from the check plants during the mid-day period.

In contrast to the retarding effect due to a lowering of the leaf temperature and the overbalancing of this retardation during all of the night period and about half of the day period is the drying effect of bordeaux mixture. Plants treated on the upper side of the leaves only lost 14 per cent more water than the untreated plants during the whole 24-hour period (See last column in second section of Table 1). This was made up of an increase of 4 per cent for the day period and 128 per cent for the night period. This drying effect was increased by placing bordeaux on both sides of the leaves to 5 and 371 per cent, respectively, for the day and night periods, or 35 per cent for the 24-hour period.

Some of the effects of sunlight and air humidity on the relationship existing between the presence of bordeaux mixture on a plant and its transpiration rate may be shown by comparing the average losses on a number of cloudy, humid days with those of an equal number of fair, dry days, as shown in Table 2.

The accelerating effect was much greater proportionately on cloudy days than on clear ones. This might be expected since the former type of day is more comparable to the night period. With bordeaux mixture on the upper side of the leaves only the transpiration rate was increased only 1 per cent over the untreated plants on fair days; whereas on cloudy ones it was 11 per cent greater. With bordeaux mixture on both sides of the leaves the average rate of water loss was only 99 per cent as great as from the untreated plants on fair days; whereas, on cloudy days the situation was reversed with the treated plants losing 21 per cent more water than the untreated ones. The

7. Tilford, P. E. and C. May. The effect of bordeaux mixture on the internal temperature of potato leaflets. Phytopath. 19: 943-949. 1929.

general effect of air humidity on the relative rate of water loss from treated and untreated plants with the light effect eliminated is illustrated by the night values. With the upper side only treated the average increase in the rate of water loss was 116 per cent during dry nights, in contrast to an increase of 152 per cent during nights of high humidity. With both sides of the leaves treated the increases were 320 and 470 per cent, respectively.

TABLE 2.—Effect of Bordeaux Mixture on the Transpiration Rate of Coleus Plants on Fair (Low Relative Humidity) and Cloudy (High Relative Humidity) Days. Values Given as Percentages of Loss of Untreated Plants

Treatment	7 P. M. to 7 A. M.		7 A. M. to 7 P. M.		24-hour period	
	Fair	Cloudy	Fair	Cloudy	Fair	Cloudy
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Both sides of leaves.....	420	570	99	121	123	163
Lower side only.........	359	470	94	112	114	145
Upper side only	216	252	101	111	109	124

SUMMARY

The daily curves of changing stomatal aperture are very similar for sprayed and unsprayed Coleus plants. However, the comparative transpiration rates of treated and untreated plants vary widely during different portions of the 24-hour period. The former loses much more than the latter during periods of darkness; whereas the untreated plants lose slightly more than the treated ones during the mid-day period. Bordeaux mixture may be a deterrent to stomatal transpiration at all times but it causes a decided acceleration to cuticular transpiration during the night period. As a result of this action the transpiration curve of a bordeaux-treated plant resembles more closely the evaporation curve of a black atmometer than does that of an untreated plant. The cooling effect of a film of bordeaux mixture only on the upper sides of the leaves of a Coleus plant is estimated to cause a decrease in the transpiration rate equivalent to 8 per cent of that of an untreated plant during the mid-day period. This effect was counterbalanced and even exceeded by a drying action during the rest of the daylight period. Bordeaux mixture increased the transpiration rate of sprayed Coleus plants over that of untreated ones to a greater extent on days of low light intensity and high air humidity than on bright, dry days.

PROBABLE COST TO OHIO FARMERS OF A GENERAL SALES TAX

H. R. MOORE

The need for public revenue has brought the general sales tax into the limelight as a legislative issue. Farmers, as well as other citizens, are asking themselves how a general sales tax may affect their business and living expenses. A prediction of the ultimate burden of a sales tax on the farm population is none too reliable for a number of reasons: In the first place, the future level of various commodity prices upon which a sales tax must rest is unknown. In the second place, the influence of a sales tax itself on prices is not entirely predictable.

Will various commodity prices be raised less, the same, or more than the amount of the tax? In other words, will the tax be borne partly by producers and dealers or, as is more commonly supposed, entirely by the consumers? Or, as sometimes happens, will the consumers' price be raised considerably more than the amount of the tax? Then again, can the tax be administered so as to prevent pyramiding through imposition of the tax first on separate commodities that later are incorporated into one commodity? For instance, will the tax apply first to the fertilizer and machinery the farmer uses to produce corn which he later sells to the elevator, then a second time to the same corn sold to another farmer to produce pork, and a third time to the pork sold as bacon? The above queries are given as a caution against too strict an application of the following data.

What would a general sales tax have cost the farm population in the period 1920 to 1932? Assuming that the tax was at the rate of 2 per cent on sales of tangible goods sold for consumption, levied only once on each commodity, and that the consumer would have paid the tax, the following estimates have been made: At the 1920 level of prices the farmers of Ohio would have paid approximately 7 million dollars a year if a 2 per cent sales tax had applied to their farm business and living expenses.[1] This would have been a tax averaging a little less than $28 per farm. With the decline of prices during the next decade the amount of tax would have been less, averaging about 4.5 million dollars annually from 1921 to 1930, inclusive. At the 1932 level of prices and expenditures the tax would have amounted to about 2.1 million dollars, or less than $10 per average farm. Since these amounts are estimated on the basis of a 2 per cent tax, the results of a 1 per cent or 3 per cent tax would be in proportion.

A general sales tax is being considered as a partial replacement for the property tax. If a constitutional amendment is adopted limiting property tax rates to 10 mills in lieu of the present 15 mills, some new source of revenue will become imperative. The question arises as to the relative burden of a sales tax as compared with the property tax. In terms of tax burden on the

[1]Business expenses subject to a sales tax are based on estimates of agricultural income and expenses made by V. R. Wertz, Department of Rural Economics, Ohio Agricultural Experiment Station. Farm living expenses subject to a sales tax are based on farm family account records assembled by Thelma Beall, Home Management Specialist, The Agricultural Extension Service, The Ohio State University.

farm population a 2 per cent sales tax would be approximately equal to 1.6 mills of property taxation, when calculated on the level of 1932 prices and farm tax valuations. It may be added that the average rural tax rate, upon which 1932 tax collections were based, was 17.453 mills on each dollar of valuation.

Another interesting comparison is with the gasoline tax paid by farmers in 1932. It is estimated that farmers paid at least $5,000,000 to the State and local governments in gasoline taxes in 1932. This is more than double the cost of a 2 per cent general sales tax to the farmers of Ohio at the 1932 level of prices.

A conservative estimate of the total yield of a 2 per cent general sales tax[2] in Ohio, at the 1932-1933 level of prices, is a little less than $25,000,000. Of this total, farmers would contribute less than 10 per cent in a year such as 1932. In more prosperous times the farm population would have a greater relative purchasing power and would pay a proportionately larger share of a sales tax.

[2]Made by W. D. Hooper, Bureau of Business Research, College of Commerce and Administration, The Ohio State University.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

The general price level which rose from 88 in March to 101 in August remained practically stationary from the middle of July to the middle of September. During the month of August, however, the price of products sold by farmers declined from 76 to 72; whereas the prices paid by farmers for commodities purchased increased from 105 to 112. As regards price, therefore, the farmer was in a worse position in the middle of September than at the middle of July. When compared to 7 months ago, however, there had been much improvement.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	......	100	100	104	100	105	100
1914	99	100	101	102	102	102	105	107
1915	102	101	106	100	103	107	106	110
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	141	232	156	139	169	96	154	147
1929	139	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	128	130
1931	107	207	129	80	120	82	89	93
1932	95	178	110	57	92	70	63	67
1932								
January	98	191	115	63	100	...	69	81
February	97	189	114	60	.....	......	64	68
March	96	189	112	61	......	70	64	67
April	95	183	111	59	94	......	64	65
May	94	177	109	56	...	......	61	63
June	93	174	108	52	......	......	59	61
July	94	171	107	57	90	......	63	67
August	95	172	107	59	......	......	66	73
September	95	177	106	59	......	......	64	67
October	94	177	105	56	84	......	61	68
November	93	171	104	54	......	......	61	56
December	91	170	103	52	......	......	60	96
1933								
January	89	164	102	51	75	......	55	62
February	87	164	101	49	......	......	53	61
March	88	163	100	50	......	59	53	54
April	88	165	101	53	70	......	59	60
May	92	169	102	62	......	......	71	72
June	95	172	103	64	......	......	70	82
July	100	175	105	76	73	......	83	96
August	101	......	112	72	......	......	79	93

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 525. Flower Growing, by Alex Laurie, V. H. Ries, L. C. Chadwick, and G. H. Poesch. This is a practical manual on growing of ornamental plants. For the reader's convenience the information is arranged topically under the various practices of gardening. Such topics as soils, propagation, use of plants, and storage include under each head the recommendations for each type of garden flower discussed. In addition to the general information contained, experimental data are presented under specific crops.

Bulletin 526. Twenty Years of Ohio Agriculture, 1910-1930, by J. I. Falconer. The period from 1910 to 1930 was one of marked change in Ohio agriculture. These changes are discussed under such general headings as growth of population and industry, transportation, farm machinery, prices and income, agricultural education and organization, farm life, and land in farms and volume of production. Figures are also given for the average area under cultivation and the average yield of specific crops for the period 1910 to 1930.

Bulletin 527. Dusting Versus Spraying Apple Orchards in Ohio, by F. H. Ballou and I. P. Lewis. This includes a brief summary of some of the interesting features of the 7-year dusting versus spraying project carried on by the authors. It was concluded that equally thorough spraying and dusting resulted in satisfactory control and that the average cost of dusting and spraying is about the same.

Bulletin 528. Dependable Fruits—Varieties for Commercial and Home Use, by C. W. Ellenwood and J. S. Shoemaker. Characteristics of varieties of most of the common tree and small fruits are given. The comments on the varieties discussed are based mainly on their behavior in the Ohio Experiment Station orchards, vineyards, and small fruit plantings. In most instances, however, the conclusions reached as to the value of a variety have also been influenced by its performance elsewhere in the State.

Bulletin 529. Some Rural Social Agencies in Ohio—A Study of Trends, 1921-1931, by C. E. Lively. This bulletin includes a revision of an earlier publication printed in 1922 and gives summary information regarding the distribution and activities of certain organizations and agencies operating in rural Ohio, together with some of the changes that have occurred during the period 1921-1931. Such topics as rural schools, rural libraries, the rural newspaper, the rural physician, the Young Women's Christian Association, Young Men's Christian Association, Boy and Girl Scouts, etc. are treated.

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Ohio Agricultural Experiment Station

WOOSTER, OHIO, U. S. A.

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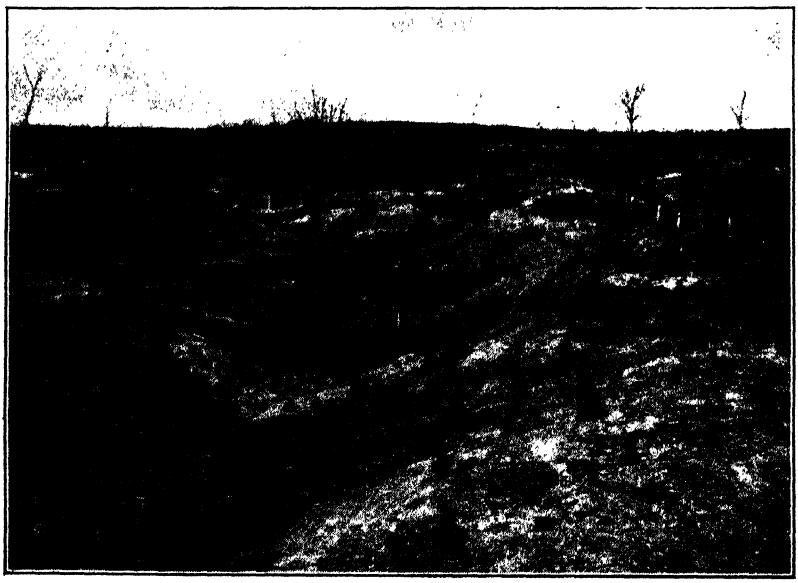
Free Bulletin

C. G. Williams

Director

The land shown in the view above was once a cultivated field. It has long since passed its usefulness for any purpose but forest trees



The above picture shows gullied lands that are being reclaimed with simple wood dams and pine trees. This work is being done by the Civilian Conservation Corps workers in Ohio

FATTENING STEER CALVES

PAUL GERLAUGH

Previous work on the feeding of molasses to steer calves is reported in Bulletin 463 and Bimonthly Bulletins 154 and 159 of this Station.

It was felt advisable to continue the use of ½ and 1 pound of molasses in a ration similar to the ration used in the previous tests with molasses.

Bimonthly Bulletin 159 contains the results derived from a lot of calves fed a protein supplement containing one-third each of dry-rendered tankage, cottonseed meal, and linseed meal. As an outgrowth of the results of this lot of calves, an all-purpose supplement was made up and fed as the protein supplement for fattening calves, dairy cows, fattening lambs, fattening hogs, and laying hens.

This all-purpose protein supplement contained 30 per cent dry-rendered tankage, 30 per cent soybean oilmeal, 20 per cent cottonseed meal, 15 per cent linseed meal, 2 per cent finely ground limestone, 2 per cent special steamed bone meal, and 1 per cent salt. This supplement was fed to Lots 4 and 5 in such amounts that its protein content equalled the amount of protein in 2 pounds of the mixture of equal parts linseed meal and cottonseed meal fed to Lot 1, the check lot, and to Lots 2 and 3. Lot 5 was fed similarly to Lot 4, except for the addition of ½ pound of feeding molasses.

All lots were full fed shelled corn. The same amount of corn silage and mixed clover and timothy hay was fed to all lots. Eight pounds of silage were fed daily up to June 5, after which the amount was reduced to 7 pounds until the close of the test. Two pounds of hay were fed daily per calf until June 9, when the amount was dropped to 1½ pounds and continued at this level until the test closed.

The molasses used was cane feeding molasses, purchased from a local feed company which buys in tank car lots.

The calves used were from the E. S. Brainard Ranch of the Panhandle Region of Texas. They were sorted from a larger group at Toledo; consequently, their Texas weights are not known.

The allotment was made by the method described in Bimonthly Bulletin 159.

The health of the calves was excellent throughout the test, not a calf showing any signs of being "off feed".

Molasses increased feed consumption and rate of gain. There was evidence of increased growth in the molasses-fed lot of calves as compared with the check lot.

Lots 2, 3, and 5 were sold August 5 to Swift and Company and were shipped to their New York plant, where they were found to be "very satisfactory". At the time of the sale the three lots were referred to as having the same value, but Lot 1 was appraised 10 cents per hundredweight higher and Lot 4, 15 cents lower than these three.

TABLE 1.—Experiment 693—Steer Feeding Test (Molasses in Ration for Fattening Calves, Tankage as Part of the Protein Supplement)

From Nov. 22, 1932, to Aug. 1, 1933	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Number of steers per lot	20	20	20	20	20
Cost per cwt. in feed lot	$ 7.25	$ 7.25	$ 7.25	$ 7.25	$ 7.25
Average weight, Nov. 22, lb.	392	392	393	395	396
Average weight, Aug. 1, lb.	875	928	949	925	948
Average daily gain (252 days), lb.	1.91	2.12	2.20	2.10	2.19
Average ration, lb.:					
Shelled corn	8.75	9.75	10.09	9.58	10.15
Protein supplement*	2.00	2.00	2.00	1.66	1.66
Silage	7.80	7.70	7.70	7.70	7.70
Mixed hay	1.58	1.59	1.59	1.58	1.59
Molasses	....	0.50	1.00	....	0.50
Water (gallons) May 9 to Aug. 1	6.81	7.02	7.98	7.18	....
Feed per cwt. of gain, lb.:					
Corn	457.40	459.50	457.50	455.50	463.20
Protein supplement	104.50	94.20	90.64	79.00	75.80
Silage	406.20	366.40	352.40	369.80	354.80
Hay	82.80	75.10	72.24	75.45	72.63
Molasses	....	23.56	45.32	....	22.80
Feed cost per cwt. of gain	$ 5.87	$ 5.98	$ 6.14	$ 5.58	$ 5.85
Pork gains per steer, lb.	30.1	38.8	37.0	43.4	48.2
Necessary selling price per cwt. (feed-lot weight, with pork credited)	$ 6.35	$ 6.36	$ 6.44	$ 6.11	$ 6.23
Selling price (feed-lot weight)	$ 6.89†	$ 6.79	$ 6.79	$ 6.64†	$ 6.79
Profit per steer	$ 4.72	$ 3.99	$ 3.32	$ 4.90	$ 5.30
Returns per bu. of corn	$ 0.578	$ 0.556	$ 0.537	$ 0.573	$ 0.578

*Protein supplement for Lots 1, 2, and 3—equal parts linseed meal and cottonseed meal; for Lots 4 and 5—the all-purpose supplement, made up of linseed meal, cottonseed meal, soybean oilmeal, tankage, and minerals.

†Appraisal placed by purchaser of the other three lots.

Feed Prices: Shelled corn, 85¢ per bu. to April 11; 55¢ per bu. after that date; cottonseed and linseed protein, $22.50; all-purpose protein, $25.00 per ton; silage, $3.00 per ton; hay, $8.00 per ton; molasses, $1.10 per cwt. Pork gains figured at $4.00 per cwt.

TABLE 2.—Steer Feeding Test—Experiment 693: Tankage as Part of the Protein Supplement for Fattening Calves

From Nov. 22, 1932, to Aug. 29, 1933	Lot 1	Lot 4
Cost per cwt. in feed lot	$ 7.25	$ 7.25
Number of steers	20	20
Average weight, Nov. 22, lb.	392	396
Average weight, Aug. 29, lb.	918	972
Average daily gain (280 days), lb.	1.88	2.06
Average daily ration, lb.:		
Shelled corn	8.99	9.90
Protein supplement	2.00	1.66
Silage	7.70	7.69
Mixed hay	1.58	1.60
Feed per cwt. of gain, lb.:		
Corn	479.30	480.30
Supplement	106.60	80.50
Silage	410.30	373.20
Hay	84.00	76.50
Feed cost per cwt. of gain	$ 6.18	$ 5.92
Pork gains per steer, lb.	38	49
Necessary selling price (feed-lot weight with pork credited)	$ 6.47	$ 6.25
Selling price (feed-lot weight)	$ 6.60	$ 6.60
Profit per steer (pork credited)	$ 1.19	$ 3.33
Returns per bu. of corn fed	$ 0.49	$ 0.53

For protein supplement and feed prices used, see preceding table.

Lots 1 and 4 were fed an additional month in order to get a more desirable finish on Lot 4. During the 40-week period Lot 4 outgained Lot 1, 51 pounds per steer. The two lots were viewed by a representative of Armour and Company, who stated a preference for the finish of Lot 1. The cattle were shipped to the New York plant of the company. The dressing percentages of the two lots actually showed a slight preference for Lot 4. The carcasses of the two lots were graded the same. The returns were $6.60 per hundredweight for both lots, on feed-lot weights.

During the period between the two shipments there had been a drop in beef cattle prices, which accounts for the lower prices for Lots 1 and 4.

The supplement containing the tankage increased feed consumption and rapidity of gains at a lower cost per hundredweight of gain, as compared with the results of the lots fed the linseed meal and cottonseed meal mixture.

One-half pound of molasses added to the all-purpose protein supplement increased the feed consumption and the gains.

Water meters were installed after danger of freezing was past. An increased feed consumption caused an increased water consumption. In Lots 2 and 3 molasses was responsible for the increase in feed consumption. In Lot 4, which received no molasses, the increased feed consumption was doubtless due to the protein supplement fed.

RELATIVE EFFICIENCY AND PROFITABLENESS OF THREE GRADES OF FEEDER STEERS. III

PAUL GERLAUGH AND C. W. GAY

The third test in this series of experiments was conducted in the feed lots of the Ohio State University, under the supervision of C. W. Gay.

In the two previous tests[1], conducted in the same feed lots, the cattle were started on test at an earlier date and the tests were terminated late in May.

The months of March, April, and May are months when choice fat cattle sell relatively low as compared with the plainer grades of fat cattle. During the season of August, September, and October choice fat cattle usually command a relatively higher price in comparison with the lower grades. It was thought desirable to time the cattle used in this test for the late summer market to learn more about the relative profitableness of the three grades when marketed during the season which is usually favorable to the better grades.

The cattle were purchased at the St. Paul market on November 29, 1932, and arrived at the feed lot on December 1. The choice grade cost $5.00 per hundredweight at St. Paul; the medium grade, $4.25; and the common ones, $3.50. The price card mailed out by a feeder cattle dealer at St. Paul, under date of December 1, 1932, quoted: "Good to choice Shorthorn yearlings, consisting mostly of Dakotas, 500 to 700 pounds, bulk selling $4.00 to $4.50; a few choice ones at $5.00. Common to fair quality Shorthorns, any weight, no real bad ones among them, good doing, thrifty steers, $3.00 to $3.50." These quo-

[1]Reported in the Ohio Agricultural Experiment Station Bimonthly Bulletins 152 and 158.

tations, similar to the two preceding weekly price cards, led us to feel that a price of $5.00 per hundredweight for choice steers and a price of $3.50 for common ones would be desirable cost prices for the choice and common grades used in this test. A price of $4.25 for the medium grade was established because of its being midway between the price of the other two grades. Our order called for the best steer cattle that could be purchased for the three figures.

The steers were started on test January 3. All three lots were given the same amount of silage, hay, and protein supplement and a full feed of corn-and-cob meal. Their feed-lot performance is shown in Table 1.

TABLE 1.—Relative Efficiency and Profitableness of Different Grades of Feeder Cattle. III

—1933— January 3 to August 15 in feed-lot test State Fair auction, August 30	Lot 1 Choice	Lot 2 Medium	Lot 3 Common
Feed-lot cost per cwt.	$ 5.75	$ 5.00	$ 4.25
Number of steers in lot	12	12	12
Number of days on test	224	224	224
Average initial weight, lb.	555	564	551
Average final weight, lb.	1009	981	1014
Average daily gain, lb.	2.02	1.86	2.06
Average daily ration, lb.:			
Corn-and-cob meal	12.1	11.9	13.2
Protein supplement*	1.5	1.5	1.5
Corn silage	10.2	10.2	10.3
Mixed hay	3.0	3.0	3.0
Feed per cwt. of gain, lb.:			
Corn	599.0	641.0	638.0
Protein supplement	73.4	80.0	72.0
Silage	505.5	549.0	498.0
Hay	145.5	159.0	144.0
Feed cost per cwt. of gain	$ 4.60	$ 4.96	$ 4.73
Gain on pigs following (lb. per steer)	17	17	17
Necessary selling price per cwt. (feed-lot weight with hog gain credited)	$ 5.16	$ 4.90	$ 4.40
Selling price, State Fair auction†	$ 5.50	$ 5.35	$ 5.25
Auction selling weight (lb. per steer)	988	985	956
Profit per steer (auction sale weight and price)	$ 2.24	$ 4.49	$ 5.54
Returns per bu. of corn (auction weight and price)	$ 0.35	$ 0.42	$ 0.43
Appraisals:			
Buffalo	$ 5.75	$ 5.50	$ 5.50
Cleveland	5.75	5.50	5.50
Pittsburgh	5.75	5.50	5.50

*Supplement—equal parts linseed meal and cottonseed meal.
†Columbus Packing Company purchased one lot; David Davies of Columbus, two lots.
Feed Prices: corn-an-cob meal, 30¢ for 70 pounds; protein supplement, $24.00 per ton; silage, $2.50 per ton; hay, $7.00 per ton.

The pigs following the steers were allowed the run of the three lots, and their gains were prorated to the various lots.

The tests was terminated as far as feed-lot performance was concerned on August 15, but the cattle were fed in the same way until they were taken to the Ohio State Fair where they were exhibited and sold in connection with the car-lot show and sale.

The selling prices of the three grades showed much less variation than the purchase price. The auction sale price and weights are used in figuring the returns. It is to be noted that the common grade shrank considerably more between feed-lot and selling weights than the other lots. No explanation for this is known, but it is thought not to be due to the grade of the cattle. The feed-lot gains during the test showed the common grade usually slightly below the choice grade. It is probable that the August 15 weight of the common grade was strong and the auction sale weight light.

It should be stated that the choice steers were not as good as many good cattlemen would picture from the description. The representatives of Armour and Company, Swift and Company, and Wilson and Company who attended the show and sale stated that the choice steers were fat enough but several of the 12 were "not good enough" to entitle them to go to New York. It is very probable that, had the choice grade been good enough to justify competitive bids from the above mentioned representatives for shipment to the East, their selling price would have been high enough so that their returns would have been greater than either of the other lots. A 35 cent per hundredweight higher selling price for the choice grade would have made the returns per bushel of corn as great as those of the common lot.

In the two preceding tests, in which the choice steers were regarded as deserving of the grade, the common steers made greater returns for the feed eaten than the medium or the choice steers.

It should be remembered that the 3 years in which this test has been conducted have been years of a declining fat cattle market. In the fall of 1930, when the first test was started, choice fat cattle at Chicago were about $13.25 per hundredweight. In November of 1931, fat cattle at Chicago topped around $11.50; whereas, in 1932, about $9.25 was the highest price during the last half of the year. The year 1933 saw few cattle above $7.00 at Chicago, with a top of about $7.25 during the first 9 months.

Perhaps, with a change in the cattle market from low to higher levels, the situation favoring the common grades may be less marked.

A comparison of the results of the three tests shows very little difference in the ability of the three grades to convert feed into gains.

In the 1930-1931 test the common steers lost $1.95 per head. In the 1932-1933 test they made $5.54 per head. It is interesting to note that, from a farmer's point of view, this statement may be very misleading. In the 1930-1931 test, corn was valued at 80 cents per bushel and in 1932-1933, at 25 cents per bushel (unground). The actual returns for the corn fed in 1930-1931 were 73 cents per bushel, and in 1932-1933 the returns were 43 cents per bushel. For the farmer who feeds his own corn, the 1930-1931 feeding experience would put him ahead much more rapidly than the 1932-1933 experience, even though on paper it would not seem to be the case. The man who fed purchased corn would be ahead with the experience of the 1932-1933 bunch of common steers.

A STUDY OF THE LENGTH OF GESTATION AND SERVICE RECORD OF DAIRY COWS

C. E. KNOOP AND C. C. HAYDEN

Many investigators during the last century have reported average gestation periods for dairy cows. The averages of the number of days have ranged from 278 to 288, a variation of 10 days. Some of the very early workers, previous to this period, have reported average gestation periods of approximately 270 days. In view of this variation, it was thought that additional data would be worth preparing to make such information more conclusive.

The data here presented have been compiled from accurately kept breeding records of the Ohio Agricultural Experiment Station Holstein and Jersey herds from April 1903 to March 15, 1933.

There were 805 gestations used in this study, 432 of which are for Holstein cows and 373 for Jersey cows. The cows were registered animals with the exception of a few grades, the total number of gestations from grade animals being 15 for the Holsteins and 16 for the Jerseys. Only single-birth gestations were used in this study, all twin gestations being excluded from the final results. Those gestations shorter than 264 days and longer than 297 days were excluded.

The "gestation period" as used in this study was calculated from the day after service of the cow to the calving day, inclusive; for example, a cow served by the bull on January 1 and calving October 2 would have a gestation period of 274 days, or 275 in a leap year.

RESULTS

DATA FROM HOLSTEIN-FRIESIAN COWS

Among the Holsteins 432 births were used (Table 1) with an average gestation of 278.15 ± 0.154 days. Divided according to sex, there were 219 male calves dropped with an average gestation of 278.52 ± 0.223 days, and 213 female calves dropped with an average gestation of 277.76 ± 0.211 days. Male calves were carried in dam 0.76 days longer than female calves, which is statistically insignificant.

The 2-year-old heifers carried calves 2.58 days less than 6-year-old cows, and length of gestation gradually increased from 276.6 ± 0.286 to 279.18 ± 0.385, respectively, between these ages.

DATA FROM JERSEY COWS

Out of 373 Jersey gestations (Table 2) there were 188 male calves and 185 female calves dropped in the herd. The 373 gestations averaged 278.88 ± 0.176 days. Dividing the births according to sex, we find that the male calves were carried 279.25 ± 0.267 days and the female calves 277.55 ± 0.229 days—or the male calves were carried 1.70 days longer in dam than female calves.

Two-year-old Jersey heifers carried their calves 2.63 days less than did 6-year-old cows, the length of gestation increasing from 277.27 ± 0.825 to 279.9 ± 0.653 days, respectively.

TABLE 1.—Length of Gestation Periods for the Ohio Agricultural Experiment Station Holstein-Friesian Cows*

Age of dam in years	Male calves				Female calves				Average gestation in days
	No.	Variation in length of gestation	Average gestation in days	Standard deviation	No.	Variation in length of gestation	Average gestation in days	Standard deviation	
1	1		264.00		3	272-283	276.33		
2	50	264-288	276.88 ± 0.405	4.250	55	267-287	276.34 ± 0.402	4.415	276.60 ± 0.286
3	41	268-296	279.12 ± 0.520	4.939	31	264-286	277.16 ± 0.625	5.160	278.27 ± 0.408
4	23	272-291	279.13 ± 0.720	5.117	32	270-283	277.68 ± 0.399	3.348	278.29 ± 0.386
5	29	264-287	278.58 ± 0.582	4.642	22	271-288	278.36 ± 0 587	4.084	278.49 ± 0.417
6	22	271-289	278.90 ± 0.643	4.471	22	272-285	279.45 ± 0.422	2.934	279.18 ± 0.385
7	17	273-286	278.76 ± 0.484	2.961	10	271-282	277.50 ± 1.077	5.050	277.13 ± 0.499
8	8	270-283	277.75 ± 1.179	4.943	10	272-288	279.60 ± 0.974	4.565	278.77 ± 0.767
9	8	269-286	278.50		9	270-284	275.88		
10	9	267-285	278.33		5	271-285	276.60		
11	6	277-287	281.33		6	274-285	279.50		
12	2	284-287	285.50		4	278-285	281.75		
13	1		288.00		3	280-293	286.33		
14	2	279-289	284.00		1		285.00		
Total	219				213				
Average		264-296	278.52 ± 0.223	4.890		264-293	277.76 ± 0.211	4.570	278.15 ± 0.154
Total births	432								

*Data gathered represent a period from April 1, 1903, to March 15, 1933.

TABLE 2.—Length of Gestation Periods for the Ohio Agricultural Experiment Station Jersey Cows*

Age in years of dam	Male calves				Female calves				Average gestation in days
	No.	Variation in length of gestation	Average gestation in days	Standard deviation	No.	Variation in length of gestation	Average gestation in days	Standard deviation	
1	1	......	285.00	......	......	......	......	......	......
2	47	271-290	278.51 ± 0.444	4.509	53	269-287	276.17 ± 0.463	5.002	277.27 ± 0.325
3	41	264-293	278.24 ± 0.590	5.595	37	267-291	277.13 ± 0.580	5.230	277.71 ± 0.417
4	34	266-289	278.70 ± 0.589	5.091	25	273-288	279.28 ± 0.588	4.361	278.94 ± 0.411
5	14	266-288	280.28 ± 1.016	5.637	22	271-287	277.54 ± 0.594	4.131	278.61 ± 0.557
6	15	267-291	281.80 ± 1.111	6.337	15	272-284	278.00 ± 0.371	2.116	279.90 ± 0.653
7	10	274-297	282.10 ± 1.507	7.063	10	273-283	278.40 ± 0.715	3.352	280.25 ± 0.879
8	11	270-284	278.72 ± 0.939	4.614	8	272-287	281.50 ± 0.969	4.062	279.89 ± 0.712
9	6	273-287	279.83		4	276-284	279.75	......	......
10	2	275-279	277.00	......	3	276-281	277.66	......	......
11	1	......	287.00	......	3	275-279	276.33	......	......
12	3	275-282	278.00	......	2	274-282	278.00	......	......
13	2	283-285	284.00	......	2	268-280	274.00	......	......
14	......	......	......	......	1	......	276.00	......	......
15	1	......	280.00	......	......	......	......	......	......
Total	188	......	......	......	185	......	......	......	......
Average	......	264-297	279.25 ± 0.267	5.418	......	267-291	277.55 ± 0.229	4.625	278.88 ± 0.176
Total births	373	......	......	......	......	......	......	......	......

*Data gathered represent a period from May 1, 1903, to March 15, 1933.

HOLSTEIN AND JERSEY GESTATION COMBINED

Out of the 805 gestation periods in both breeds, 407 were for cows carrying male calves and 398 were for cows carrying female calves. The average for the 805 periods was 278.26 ± 0.117 days. The average for the 407 male calves was 278.85 ± 0.172 days; whereas the average gestation for the 398 female calves was 277.66 ± 0.155 days—that is, male calves were carried an average of 1.19 days longer than female calves. Including all cows, the average length of gestation varied from 276.92 ± 0.216 days for 2-year-old cows to 279.47 ± 0.351 days for 6-year-old cows, a difference of 2.55 ± 0.412 days. Results indicate that there is a tendency for gestation to increase slightly with older cows, as compared with 2-year-old cows.

The following average gestation periods (using the definition of a gestation period as given in this report), as reported by other persons, are compared with the average period of 278.26 days given in these data:

Average time obtained by Copeland (1) 278.51 days.
Average time obtained by Fitch and co-workers (2) 281.40 days.
Average time obtained by Knott (3) 278.90 days.

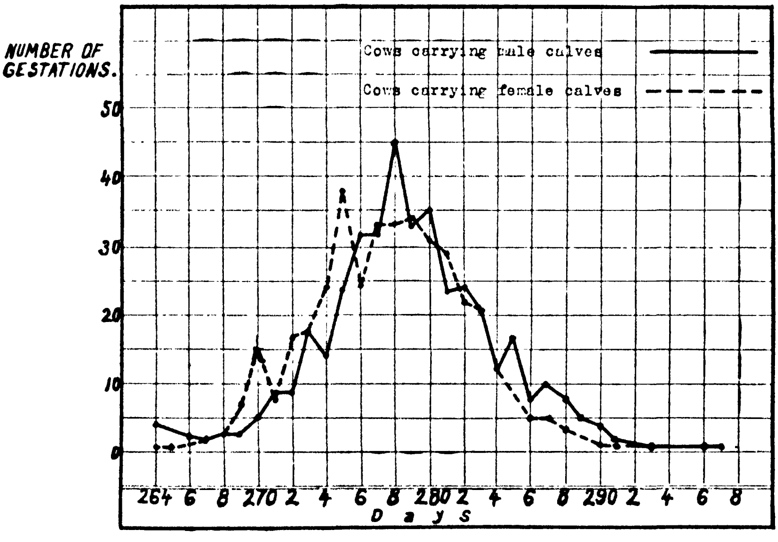


Fig. 1.—Gestation curves showing the distribution and range of Holstein-Friesian and Jersey gestations combined

Gestation curves as plotted in Figure 1 show that 26 per cent of the total number of cows dropped their calves from 269 to 275 days, 53 per cent from 276 to 283 days, 17 per cent from 283 to 289 days after service, and, on the other hand, only 3.7 per cent was for the extremely short or long period.

(1) Copeland, L. 1930. Length of gestations in Jersey cows. Jour. Dairy Sci. 13: 257-265.
(2) Fitch, J. B., P. C. McGilliard, and G. M. Drumm. 1924. A study of the birth weight and gestation of dairy animals. Jour. Dairy Sci. 7: 222-233.
(3) Knott, J. C. 1932. A study of the gestation period of Holstein-Friesian cows. Jour. Dairy Sci. 15: No. 2, 87-98.

TABLE tal Tab

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Served	Due	Served	Due	Served	Due	Served	Due	Served	Due	Served	Due	Served	Due	Served	Due	Served	Due	Served	Due	Served	Due	Served	Due
Jan.	*Oct.*	*Feb.*	*Nov.*	*Mar.*	*Dec.*	*Apr.*	*Jan.*	*May*	*Feb.*	*June*	*Mar.*	*July*	*Apr.*	*Aug.*	*May*	*Sept.*	*June*	*Oct.*	*July*	*Nov.*	*Aug.*	*Dec.*	*Sept.*
1	8	1	8	1	6	1	6	1	5	1	8	1	7	1	8	1	8	1	8	1	8	1	7
2	9	2	9	2	7	2	7	2	6	2	9	2	8	2	9	2	9	2	9	2	9	2	8
3	10	3	10	3	8	3	8	3	7	3	10	3	9	3	10	3	10	3	10	3	10	3	9
4	11	4	11	4	9	4	9	4	8	4	11	4	10	4	11	4	11	4	11	4	11	4	10
5	12	5	12	5	10	5	10	5	9	5	12	5	11	5	12	5	12	5	12	5	12	5	11
6	13	6	13	6	11	6	11	6	10	6	13	6	12	6	13	6	13	6	13	6	13	6	12
7	14	7	14	7	12	7	12	7	11	7	14	7	13	7	14	7	14	7	14	7	14	7	13
8	15	8	15	8	13	8	13	8	12	8	15	8	14	8	15	8	15	8	15	8	15	8	14
9	16	9	16	9	14	9	14	9	13	9	16	9	15	9	16	9	16	9	16	9	16	9	15
10	17	10	17	10	15	10	15	10	14	10	17	10	16	10	17	10	17	10	17	10	17	10	16
11	18	11	18	11	16	11	16	11	15	11	18	11	17	11	18	11	18	11	18	11	18	11	17
12	19	12	19	12	17	12	17	12	16	12	19	12	18	12	19	12	19	12	19	12	19	12	18
13	20	13	20	13	18	13	18	13	17	13	20	13	19	13	20	13	20	13	20	13	20	13	19
14	21	14	21	14	19	14	19	14	18	14	21	14	20	14	21	14	21	14	21	14	21	14	20
15	22	15	22	15	20	15	20	15	19	15	22	15	21	15	22	15	22	15	22	15	22	15	21
16	23	16	23	16	21	16	21	16	20	16	23	16	22	16	23	16	23	16	23	16	23	16	22
17	24	17	24	17	22	17	22	17	21	17	24	17	23	17	24	17	24	17	24	17	24	17	23
18	25	18	25	18	23	18	23	18	22	18	25	18	24	18	25	18	25	18	25	18	25	18	24
19	26	19	26	19	24	19	24	19	23	19	26	19	25	19	26	19	26	19	26	19	26	19	25
20	27	20	27	20	25	20	25	20	24	20	27	20	26	20	27	20	27	20	27	20	27	20	26
21	28	21	28	21	26	21	26	21	25	21	28	21	27	21	28	21	28	21	28	21	28	21	27
22	29	22	29	22	27	22	27	22	26	22	29	22	28	22	29	22	29	22	29	22	29	22	28
23	30	23	30	23	28	23	28	23	27	23	30	23	29	23	30	23	30	23	30	23	30	23	29
24	31		*Dec.*	24	29	24	29	24	28	24	31	24	30	24	31		*July*	24	31	24	31	24	30
	Nov.	24	1	25	30	25	30		*Mar.*		*Apr.*		*May*		*June*	24	1		*Aug.*		*Sept.*		*Oct.*
25	1	25	2	26	31	26	31	25	1	25	1	25	1	25	1	25	2	25	1	25	1	25	1
26	2	26	3		*Jan.*		*Feb.*	26	2	26	2	26	2	26	2	26	3	26	2	26	2	26	2
27	3	27	4	27	1	27	1	27	3	27	3	27	3	27	3	27	4	27	3	27	3	27	3
28	4	28	5	28	2	28	2	28	4	28	4	28	4	28	4	28	5	28	4	28	4	28	4
29	5	29	6	29	3	29	3	29	5	29	5	29	5	29	5	29	6	29	5	29	5	29	5
30	6	......	......	30	4	30	4	30	6	30	6	30	6	30	6	30	7	30	6	30	6	30	6
31	7	......	......	31	5	......	......	31	7	......	......	31	7	31	7	......	......	31	7	......	......	31	7

Table 3 has been based on 280 days, which is little longer than the average found in this report. As this is only an average, every cow should be considered due about 10 days earlier and treated accordingly. None of the calves dropped 10 days earlier or 10 days later than shown in the table should necessarily be considered premature or over due.

SERVICES REQUIRED FOR CONCEPTION

Along with the study of gestation data the number of services required for cenception were compiled, and the results are here presented. The data were collected over a period of about 30 years. A few of the early records were discarded because only the date of the service resulting in conception was recorded. In the data here used all service dates were recorded.

There were 379 Holstein pregnancies resulting in normal calvings. Of this number 58.8 per cent conceived at the first service, 21.1 per cent at the second, 10.3 per cent at the third, 4.2 per cent at the fourth, 2.4 per cent at the fifth, and the remainder after a larger number of services, one conceiving at the 15th service. The average for the total number of pregnancies was 1.87 services per conception.

There were 340 pregnancies among the Jerseys resulting in normal calvings. Of this number 65.6 per cent conceived at the first service, 24.1 per cent at the second, 6.1 per cent at the third, 1.7 per cent at the fourth, and the remainder at a larger number of services, the greatest number being 6. The average was 1.53 services per conception.

Table 4 lists the total number of births and the average number of times the cows were bred per conception.

TABLE 4.—Service Record of the Dairy Herd

Age in years	Holstein cows			Jersey cows		
	No. of calves dropped	Services per calf		No. of calves dropped	Services per calf	
		Range	Average		Range	Average
1	4	1- 3	1.50	1	....	1.00
2	95	1- 5	1.63	95	1-6	1.48
3	64	1- 9	1.89	71	1-6	1.59
4	45	1- 9	2.00	60	1-5	1.36
5	48	1- 8	1.83	32	1-6	1.60
6	38	1- 7	1.60	23	1-4	1.78
7	24	1- 6	2.10	17	1-3	1.82
8	13	1- 5	1.84	13	1-2	1.46
9	14	1-15	3.28	8	1-3	1.62
10	11	1- 8	2.10	6	1-3	1.66
11	11	1- 7	2.18	5	1-2	1.40
12	6	1- 2	1.30	4	1-2	1.25
13	4	1- 5	2.25	3	....	1.00
14	2	1- 2	1.50	1	....	2.00
15	0	0	0	1	....	3.00
Total	379	....	....	340	....	....
Average	....	....	1.87	....	....	1.53

There was very little difference noted between the number of services required by cows of various ages; this does not agree with the results of Morgan and Davis (4) who found that 2-year-old cows required 6 per cent more services per conception than 3-year-old cows, when bulls of all ages were used.

There are various causes for failure on the part of both cows and bulls to bring about conception.

Dairymen having cows which fail to conceive at the third service should have them examined by a competent veterinarian. If many cows bred to the same bull fail to conceive, the bull should also be examined.

(4) Morgan, R. F. and H. P. Davis. The influence of age of cows and age of bulls on the number of services required for conception. 27th Amer. Dairy Science Assoc. Meeting, June, 1932. p. 59.

THE LESPEDEZAS IN OHIO

A PROGRESS REPORT

The lespedezas are relatively new to Ohio agriculture. Their probable usefulness has been under investigation by the Department of Agronomy for the past 11 years.[1] Recently the number and scope of the experiments have been greatly enlarged, and it seems desirable to publish a summary statement of the present status of the lespedezas in Ohio for the benefit of those who may wish to give them a trial.[2]

Japanese or common lespedeza.—This annual legume has been grown in the southern states for the past 50 or more years and has gradually spread northward by natural means as far as the northern part of Washington, Athens, and Hocking Counties in southeastern Ohio, the apparent northern limit of natural spread. In this area, it constitutes a part of the native cover on the hilly permanent pastures. Its usefulness in this section may be increased by artificial seedings to help out the natural spread. The Japanese lespedeza, which has spread naturally into southern Ohio, is much earlier in maturing seed than that grown farther south. On the outlying experiment farms in southern Ohio seed grown in Louisiana produced plants that failed to mature seed; whereas that from Kentucky and Tennessee produced fair amounts of seed.

Japanese lespedeza has a flat, spreading habit of growth (unless the stand is very thick) and bears its seeds in the axils of leaves all along the stem; this enables it to survive and reseed itself under pasturing.

The primary use for Japanese lespedeza is for pasture in southeastern Ohio. It has little to recommend it for hay in this State.

Kobe and Tennessee No. 76.—These are varieties of the common Japanese lespedeza, somewhat larger and later maturing than the common Japanese variety native to southern Ohio. Their failure to produce seed makes them questionable for seeding in the State.

[1] "Japan and Korean Clovers"—Ohio Agricultural Experiment Station Bimonthly Bulletin, No. 130, January-February, 1928. "Lespedezas in Southeastern Ohio"—Ohio Agricultural Experiment Station Bimonthly Bulletin, No. 155, March-April, 1932.

[2] The following members of the Department of Agronomy have contributed data from their experiments with, and observations on, the lespedezas as the basis for this report: C. J. Willard, Associate (Columbus), experiments at Columbus; D. R. Dodd, Assistant (Columbus), experiments and observations on private farms, southeastern Ohio; J. S. Cutler, Associate (Wooster), experiments on the outlying experiment farms; and L. E. Thatcher, Associate (Wooster), experiments at Wooster.

Korean lespedeza.—The present active interest in Korean lespedeza is due largely to its popularity in Kentucky, Tennessee, Missouri, and other southern states where it has come into prominence during the past decade as a forage and seed crop. Korean lespedeza matures its seed earlier than Japanese. It has matured seed regularly at Wooster, and in 1933 some seed ripened on the Trumbull County Experiment Farm and for 3 years on the Northwestern Experiment Farm in Henry County. It has a more upright habit of growth than the Japanese and bears its seeds near the tips of the branches. For this reason, it has failed to reseed itself as successfully as the Japanese under close pasturing.

At Columbus, Korean lespedeza was sown in 1922-1925, 1932, and 1933. The results for 1922-1925 indicated no special place for the Korean lespedeza on the limestone soils of western Ohio. Two seedings made on April 15, 1932, produced 1 ton per acre of hay by October 10. From this seeding a weedy volunteer stand in 1933 produced only ¾ ton of hay. New seedings were made in the spring of 1933 with companion crops of wheat, oats, first- and second-year sweet clover, as well as being sown with no companion crop, at rates of 10 and 20 pounds per acre, and with and without commercial inoculation. Yields of hay made September 9 ranged from 680 to 3810 pounds (average, 1780 pounds) per acre and averaged 11.4 per cent crude protein (five separate tests). Seedings made alone outyielded those made with companion crops. Those made with second-year sweet clover were total failures. In a mixture of sweet clover and lespedeza (sown in oats) the fall growth of the sweet clover was larger than that of the lespedeza. Twenty pounds of seed gave slightly higher yields than 10 pounds. All seedings showed abundant nodule formation whether inoculated artificially or not.

Fifteen experimental plantings of Korean lespedeza were made on southern Ohio farms in 1933. It showed promise of value for late summer and early fall pasture in that section and may be a valuable supplement to permanent pastures as far north as the National Highway. Its value for meadows, however, is problematical even on soils which will not grow the clovers successfully. Further research is needed on that point. It has considerable promise as a cover crop in orchards in southern Ohio.

Korean lespedeza was included in the regular meadow mixtures, at the rate of 3 pounds per acre, sown on wheat in the spring of 1933 on nine of the outlying experimental farms. The stands obtained ranged from 3 to 30 per cent and were from 3 to 10 inches in height. Apparently the amount of growth was determined largely by the summer rainfall, the fertility of the soil, the location in the State, and the amount of competition from other plants in the mixture. Sufficient seed ripened in the fall in all these tests to produce a good volunteer stand in next summer's aftermath, providing the stands of the clovers and timothy are not too thick. Seedings were also made with oats on seven farms, five being pure Korean lespedeza and two in mixtures with clovers. Stands ranged from 20 to 90 per cent and the height from 4 to 10 inches.

The growth of the Korean lespedeza was best in the tests in the southern part of the State and, in general, was best sown without the addition of other clovers.

At Wooster in 1933, 20 pounds of Korean lespedeza seed per acre sown on winter wheat produced better stands than 10 pounds but not twice as good. Seedings made from December 20 to April 13 (five dates) were all fair to good

with the best stand obtained from March seeding. The plants started active growth in mid-August, were blooming in mid-September, and ripened seed early in October. The average maximum height for the season was 4 inches.

Similar growth was obtained in oats where it was sown alone and with red clover. The red clover plants made more fall growth than did the Korean lespedeza.

Fairly thick volunteer stands of Korean lespedeza have been obtained for 2 years at Wooster; whereas the Japanese has volunteered but little. At no time has the growth been large enough to make much hay.

Korean and Japanese lespedeza were pastured with sheep and the Korean with dairy calves in 1933 at Wooster.[3]

Sown on thin Canadian blue-grass sheep pasture on March 16, Korean and Japanese lespedezas made fair but very spotted stands. Active growth did not start until mid-August, which was too late to help out the July-August blue-grass shortage; moreover, the maximum height of the lespedeza was not over 4 inches and it furnished but little pasture. Sheep also pastured wheat stubble containing a good stand of Korean lespedeza from August 22 to September 7. It afforded little pasture. Similar results were obtained with dairy calves from August 23 to August 28.

An early strain of Korean lespedeza, No. 65280[4], (sometimes called Harbin lespedeza) has been introduced recently for testing in northern territory. At Wooster in 1933, it bloomed on July 18; seed began to ripen early in September and matured fully by September 22, at which time the standard Korean was in full bloom. At Columbus, the early strain was ripe by mid-August but yielded only one-half as much hay as the standard Korean.

TABLE 1.—*Lespedeza sericea* in 2-foot Rows—Columbus
(Sown April 6, 1932, and cultivated)

Plot	First cutting			Second cutting		
	Date	Hay, yield per acre	Crude protein*	Date	Hay, yield per acre	Crude protein*
		Lb.	*Per cent*		*Lb.*	*Per cent*
1	June 28, 1933	4390	13.1	Sept. 20	2700	14.5
2	July 7, 1933	4120	12.6	Sept. 20	1800	16.9
3	July 14, 1933	3150	11.9	Sept. 20	1710	17.6

*7% moisture basis.

Lespedeza sericea.—This perennial lespedeza is also increasing in popularity in the South where it is grown largely for seed at the present time but promises to become a valuable legume for hay and pasture in that territory. Being a perennial, it may serve as a substitute for alfalfa on soils too acid for that crop. Its value for Ohio is still uncertain. Under favorable conditions it grows 2 to 4 feet tall but is rather coarse-stemmed and produces a hay of lower feeding value than alfalfa. At Columbus in 1932, a small plot in cultivated rows 2 feet apart yielded at the rate of 2½ tons of hay in 1932 (one cutting) and 3½ tons in 1933 (two cuttings). No seed matured satisfactorily in either year. Two broadcast seedings were made in 1933, but poor stands were

[3]In cooperation with D. S. Bell and C. F. Monroe, Associates in Animal Industry and Dairy Industry, respectively.

[4]The Ohio Station is indebted to Mr. C. R. Enlow, associate agronomist, Office of Forage Crops and Diseases, United States Department of Agriculture, Washington, D. C., for seed of this early Korean lespedeza (F. C. 65280) for trial.

obtained under conditions where alfalfa made good stands and yields. The second cutting in 1933 contained more protein than the first cutting, and the percentage of protein in the second cutting increased as the first cutting was made later, as shown in Table 1.

On November 2, 1933, the dry roots of *Lespedeza sericea* (the tops of which had not been harvested) amounted to 2190 pounds per acre and contained 2.37 per cent nitrogen, compared with 1900 pounds per acre and 1.73 per cent nitrogen where the tops had been cut June 28 and September 20.

An early strain, F. C. 04730, of this perennial lespedeza was sown on 15 farms in southern Ohio in 1933. The season's growth varied from 3 to 40 inches in height. In the extreme southern part of the State some seed matured. It did not respond to applications of lime or fertilizer to the soil. In general, the tests indicated that *Lespedeza sericea* may do fairly well on soils too acid for alfalfa and the clovers. Seedings made in cultivated rows made more growth than broadcast seedings.

At Wooster, a broadcast seeding made in 1932 with a light companion crop of early oats made a fair stand but was only 6 to 8 inches tall and unbranched when winter set in. Many plants were killed the following spring by heaving. Those that survived grew to a maximum height of 15 inches in 1933 but failed to ripen seed. A broadcast seeding made in 1933 reached a height of 4 to 6 inches and was killed back by frost on October 14.

Native lespedezas.—Several wild perennial lespedezas native to Ohio are being studied to learn if they have any agricultural value when domesticated.

SUMMARY AND CONCLUSIONS

Experiments have been carried on with the annual lespedezas—Japanese or common, Korean, Kobe, Tennessee No. 76— and the perennial, *Lespedeza sericea.*

The lespedezas as a group apparently are somewhat better adapted to growing on acid soils and thin soils than are the common clovers. Their reputed drouth resistance has not been observed in these tests—they have suffered as greatly from drouth as the clovers and more so than alfalfa.

Ohio lies on the northern edge of the most favorable environment for the growth of the lespedezas; failures may be expected more frequently here than farther south. Their greater dependability in the South may be due partly to the longer growing season and partly to a more favorable length of day.

In the southern third of the State, Japanese and Korean lespedeza appear to be promising, the Japanese for reinforcing native pastures from the Ohio River north to the northern boundary of Washington, Athens, and Hocking Counties (the approximate northern limit of natural spread) and the Korean for similar pastures as far north as the National Highway.

The Korean may be used for hay in favorable seasons either as pure stands or in mixtures and where the soil is too acid for a good growth of clover. Korean lespedeza is in no sense a substitute for the clovers where and when they can be grown. It may also have some value for pasture early in the fall under similar circumstances.

Korean lespedeza has made a good growth as a cover crop in orchards in southern Ohio.

The growth of Japanese and Korean lespedeza is much reduced by a good growth of grass, clover, or other competing plants.

The annual lespedezas do not make much growth in Ohio until July or August and are killed by the first heavy frost.

When seeding lespedeza for the first time on a field, it is advisable to inoculate the seed—some soils are already inoculated but many are not.

Care should be exercised in the purchase of lespedeza seed, because much of it contains dodder seed and some lots that have been sold for Korean have contained a high percentage of Kobe. The safe plan is to buy only inspected certified seed or seed guaranteed by a reliable dealer.

Korean lespedeza should be sown on wheat in March or April—early enough so that the freezing and thawing of the soil will cover the seed if broadcast—or drilled on and covered as soon after as the soil can be worked. Early seeding is desirable when sown on permanent pasture. If sown with oats, the seedbed should be firm and the seed covered shallow. Ten to 20 pounds of seed should give a good stand the first year, or 5 to 10 pounds will reseed the land for a good volunteer stand the second year.

Unscarified seed of *Lespedeza sericea* should be sown early since frost action is necessary to soften the seed coats and permit germination. The scarified seed germinates quickly and should not be sown before danger of heavy frost is over because the sprouted seeds are very tender. Two pounds of scarified seed or 4 to 5 pounds of unscarified seed will sow an acre in 2½-foot rows for cultivation or 20 to 25 pounds if broadcast for a solid seeding. Shallow covering is required.

The experiments with *Lespedeza sericea* have been too limited in time and scope to determine its value for Ohio, and further research will be carried on. So far it has shown little promise. Farmers should make only small seedings for observation, if at all, until its value has been established.

A NOTE ON THE HARDINESS OF BUDS OF PEACH VARIETIES

J. S. SHOEMAKER

The season of 1933 provided a splendid opportunity to secure information on the hardiness (resistance to low winter temperature) of buds of different peach varieties. Practically all Elberta buds at Wooster were winterkilled; whereas enough buds survived on some varieties for a full crop and on other varieties enough buds survived for a partial crop. Thus, all varieties that fruited in 1933 are hardier than Elberta.

During the winter of 1932-1933 the following sub-zero temperatures were recorded at a weather station which is located about ¼ mile from the Peach Variety Orchard.

December 16	—10° F.
December 17	— 5° F.
February 9	— 8° F.
February 10	— 8° F.
February 12	— 1° F.

The temperature records (as shown by data compiled by C. A. Patton, in charge of the weather records at the Ohio Experiment Station) for a weather station located about 1½ miles from the Peach Variety Orchard are as follows:

	Max. °F.	Min. °F.	Mean °F.	Mean for 44 years °F.
November 1932	68	12	39.2	40.5
December 1932	62	—10	31.7	30.5
January 1933	68	10	37.5	27.1
February 1933	59	— 6	31.8	27.4
March 1933	64	8	37.3	37.7
April 1933	78	27	50.6	48.5

More than 3,000 buds of peach varieties were examined individually in January, 1933. At that time, there were still enough buds alive to warrant the expectation of a good crop, even on Elberta. Some damage (about 20 per cent on Elberta) had been caused by the low temperatures of mid-December, but the damage was not severe with any variety examined.

The mean temperatures for November and December, 1932, and February, 1933, were not very far from the average for 44 years. However, it is noteworthy that the January, 1933, mean temperature was 10.4° above the mean for 44 years. Apparently, a chief factor associated with the killing of the buds of the more tender varieties was the abnormally warm January which forced the buds beyond normal development. Subsequently, the February sub-zero temperatures resulted in the death of most of the buds on the more tender varieties and seriously reduced the number of live buds on many other varieties.

Notes were taken of the amount of bloom of the different varieties. From these records it was possible to classify the varieties with respect to hardiness of buds. However, the classification would be practically the same as that which is shown when the varieties are grouped according to yield.

Since all peach varieties available from nurserymen, including some of the hardiest ones, are not now fruiting at Wooster the list presented in Table 1 is a restricted one. The Rochester variety, for example, is not included in the record of this report; this variety bore heavily in 1933 in some nearby orchards and undoubtedly deserves the rank of one of the hardiest of the yellow-fleshed varieties. Belle of Georgia (a leading white-fleshed variety) is not included either; in nearby orchards this variety produced a crop but not the equal of that of Carman.

The groups that have been arranged are arbitrary, because in some cases the yield the previous year (1932) and perhaps also in the exceptionally heavy crop year of 1931 should rightfully be considered in evaluating the hardiness of the varieties (1, 2.) The case of J. H. Hale is an interesting example of the role of "tree exhaustion". In 1931, this variety averaged 6.5 bushels per tree; Elberta, of the same age, averaged 6.4 bushels. In 1932, J. H. Hale averaged only 1.3 bushels per tree; whereas Elberta averaged 5.3 bushels. Perhaps the lighter crop on J. H. Hale in 1932 is one reason why it produced more than Elberta in 1933.

It has recently been shown in New Jersey (3) that the standard of hardiness of our recommended variety lists of peaches is being reduced by the dominance of Elberta and varieties of the Elberta and J. H. Hale type. Elberta and J. H. Hale do not transmit hardiness but tend rather to reduce it when hybridized with varieties more hardy than they.

(1) Shoemaker, J. S. Peach thinning. Ohio Agr. Exp. Sta. Bull. (In Press).

(2) Ellenwood, C. W. and J. S. Shoemaker. Dependable fruits. Ohio Agr. Exp. Sta. Bull. 528, 1933.

(3) Blake, M. A. Elberta and its selfed and chance seedlings lack hardiness. N. J. Agr. Exp. Sta. Circ. 287, 1933.

TABLE 1.—Hardiness of Buds of Peach Varieties as Indicated by Yield per Tree in 1933

Hardiest crop (1 bu. or more)			Light crop (¼-¾ bu.)			No crop (Perhaps an occasional fruit)		
Variety	Planted	Bu.	Variety	Planted	Bu.	Variety	Planted	Bu.
Carman	1926	6¾	Fitzgerald	1923	¾	Elberta	1923	0
Heidelberg	1923	5¾	Heath Cling	1923	½	Wilma	1923	0
Hope Farm	1927	5½	Goldmine Nectarine	1927	½	Early Elberta	1923	0
Lemon Free	1923	4	Salberta	1923	½	Big Red	1927	0
Banner	1923	4	J. H. Hale	1923	½	Brackett	1923	0
Pioneer	1924	3½	Hunter Nectarine	1928	¼	Primrose	1927	0
New Prolific	1923	3½	Valiant	1929	¼			
South Haven	1927	3¼	Eclipse	1927	¼			
Champion	1926	3¼	Golden Jubilee	1927	¼			
Wooster	1926	3¼	Cumberland	1927	¼			
Seedling*	1923	3½						
Kalamazoo	1923	2½						
Veteran	1928	2						
Radiance	1927	1¾						
Marigold	1927	1¾						
Buttercup	1927	1¼						
Oldmixon	1923	1						
Smock	1923	1						
Vedette	1929	1						

*Bought as Salwey it proved to be a seedling with small, white-fleshed fruits. Seeds from such seedlings are esteemed for budding work.

TABLE 2.—Size of Peaches by Varieties. Varieties Arranged in Order of Ripening, 1933

Variety	Tree No.	Date of first picking		Peaches per tree	Size		Color
					2¼ in. up	2¼-2 in.	
				No.	*Pct.*	*Pct.*	
Buttercup	52	July	26	259	13.5	57.5	Yellow
Marigold	124		26	630	0.9	56.1	Yellow
Pioneer	51	Aug.	5	475	84.9	11.6	White
Golden Jubilee	107		11	20	85.0	15.0	Yellow
Cumberland	114		12	38	89.2	10.8	White
Radiance	115		15	211	96.2	1.9	White
Carman	96		15	911	90.1	9.7	White
Vedette	23		21	126	89.7	5.6	Yellow
South Haven	105		21	398	94.2	5.0	Yellow
Valiant	61		22	33	87.9	9.0	Yellow
Veteran	119		23	211	94.3	5.7	Yellow
Eclipse	108		25	*	....	....	Yellow
Champion	88		28	541	56.9	28.1	White
Fitzgerald	25		28	130	69.2	16.9	Yellow
Goldmine Nectarine	111		30	112	21.4	50.0	White
Hunter Nectarine	71	Sept.	1	*	....	....	Yellow
Heidelberg	47		1	1014	54.3	27.5	Yellow
New Prolific	35		1	608	65.5	25.2	Yellow
J. H. Hale	27		4	54	62.9	20.4	Yellow
Elberta (estimated)	....		5	No crop	....	....	Yellow
Oldmixon	21		6	152	81.6	13.2	White
Hope Farm	116		6	880	84.0	9.0	White
Kalamazoo	38		6	426	52.3	34.8	Yellow
Wooster	90		9	703	68.8	19.8	Yellow
Salberta	18		18	*	....	....	Yellow
Banner	30		18	669	86.7	8.9	Yellow
Lemon Free	46		22	779	69.4	26.1	Yellow
Smock	31		29	159	83.5	12.7	Yellow
Heath Cling	12	Oct.	5	....	....	....	White

*The record consisted of total yield only.

The size, color, and date of first picking of the varieties bearing at Wooster in 1933 are shown in Table 2. It will be noted that only three of them (namely, Radiance, South Haven, and Veteran) produced a higher percentage of the largest-sized fruit than did Carman; and Carman, whose fruit characteristics are well known, led all others in bushels per tree.

It is undoubtedly true than many peach plantings have been made in parts of Ohio and on sites where the matter of hardiness should have received more attention. Under such conditions (providing there are reasonable prospects for success with peaches), hardiness may outrank most other factors. Then, notably hardy varieties, such as Carman and Rochester, would be appropriate selections. On the other hand, in years or on sites where buds of Elberta or other relatively tender varieties of primary commercial handling qualities survive the winter in adequate number for a satisfactory crop, the hardiest varieties may rank secondary in value, because (a) they may set so heavily that the expense of certain practices, such as thinning and propping to prevent limb breakage, is comparatively high, and (b) they are, as a rule, deficient in one or more important characteristics, such as firmness and size of fruit. Hardiness is not necessarily the chief criterion of the value of a peach variety, but it is a very important factor.

INFLUENCE OF BORDEAUX MIXTURE AND AN OIL EMULSION ON WATER REQUIREMENT

J. D. WILSON AND H. A. RUNNELS

The water requirement of plants, or the ratio between the amount of water absorbed during the growing period to the amount of dry matter produced, has been shown to vary widely with climatic and soil factors and with the species. Briggs and Shantz (1) have reviewed the literature on water requirement up to 1913. Shantz and Piemeisel (2) used a large number of plant species and found the water requirement to vary from 216 for Kursk millet to 1131 for Franseria. Kiesselbach (3) found the water requirement of corn to be 40 per cent greater in an infertile soil than in a fertile one. In this connection, he also found the water requirement to be unnaturally high if the experimental plants were grown in containers too small for their proper development. Variations in the climatic complex from year to year are also important in determining the magnitude of the water requirement ratio. Miller (4) and others have found that large water requirement values are coincidental with high evaporation rates, the latter serving as a kind of summation of many of the factors influential in regulating the transpiration rate of plants. Montgomery and Kiesselbach (5) found the water requirement of corn grown in a dry greenhouse to be 56 per cent greater than that of another lot grown in a humid house.

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(1) Briggs, L. J. and H. L. Shantz. The water requirement of plants. II. A review of the literature. U. S. D. A., Bur. Plant Indus. Bull. 285, 1-96, 1913.

(2) Shantz, H. L. and L. N. Piemeisel. The water requirement of plants at Akron, Colo. Jour. Agr. Res. 34: 1093-1190, 1927.

(3) Kiesselbach, T. A. Transpiration as a factor in crop production. Neb. Agr. Exp. Sta. Res. Bull. 6, 1-214, 1916.

(4) Miller, E. C. Relative water requirement of corn and sorghums. Kan. Agr. Exp. Sta. Tech. Bull. 12, 1-84, 1923.

(5) Montgomery, E. G. and T. A. Kiesselbach. Studies in the water requirements of corn. Neb. Agr. Exp. Sta. Bull. 128, 1-15, 1912.

Bordeaux mixture has been found by numerous workers to increase the transpiration rates of plants to which it is applied (6, 7, 8). Kelley (9) states that oil emulsion sprays check the transpiration rate, some of them as much as 50 per cent or more. As mentioned in the preceding paragraphs, variations in certain factors of the environmental complex cause corresponding variations in the water requirement. Consequently, the addition of a spray material like bordeaux mixture (which decreases the amount of light which penetrates the leaf, lowers the leaf temperature, increases the transpiration rate, and, perhaps, interferes with a normal gas exchange between the leaf and the air surrounding it) should also affect the water requirement. Likewise, an oil emulsion which alters the leaf physiology to some extent should have an effect. Accordingly, these two spray materials, as well as a half and half mixture of the two, were applied to a number of different species and the water requirement of the treated plants compared with untreated checks.

Coleus, cucumber, tomato, and potato were selected from a large group which had been previously tested as species which showed a representative and varied transpiration response after the application of bordeaux mixture. About January 1, 1933, plants of each species were started in a considerable number of one-gallon tinned cans containing a known weight of soil. These containers, according to Kiesselbach (3), may not have been large enough to allow a strictly normal development of the plants used, but, since we are here interested only in relative values of the water requirement, this should not be a serious handicap. This soil was a rich, silt loam compost with a water-holding capacity of 60 per cent on the basis of dry weight. Two soil-moisture contents were used for each species, one of 50 per cent of the water-holding capacity and the other of 25, or 30 and 15 per cent, respectively, on a dry-weight basis. As soon as the plants were well established 16 plants of each species, of approximately the same degree of vigor and size within the species, were selected from the higher soil-moisture group. This was then repeated from the low soil-moisture group. Of the 16 Coleus plants in each soil-moisture group, four were treated with a 4-6-50 bordeaux mixture, four more with Volck spray oil (heavy) 1-100, four more with a half and half mixture of these two spray materials, and the remaining four were left untreated as checks. The same procedure was followed for each of the other species. Evaporation from the soil surface was prevented by tying oil cloth over the top of the can (see Figure 1). The cans were then weighed each day and sufficient water was added, through a tube extending to the bottom of the can, to bring the container back to its original weight. As the plants grew in size, allowance was made for their approximate weight in order that the net weight of the moisture in the soil might be kept constant. The plants were grown over a period of 4 weeks and applications of the spray materials were made each week. At the end of this 4-week period the plants were cut off at the soil surface and the green and dry weights of the tops were determined. The experimentation was repeated later in the season for each species except the potato.

(6) Duggar, B. M. and W. W. Bonns. The effect of bordeaux mixture on the rate of transpiration. Ann. Mo. Bot. Gard. 5: 153-176, 1918.

(7) Martin, W. H. and E. S. Clark. Influence of bordeaux mixture on transpiration. N. J. Agr. Exp. Sta. An. Rept. 50, 249-255, 1929.

(8) Wilson, J. D. and H. A. Runnels. Some effects of bordeaux mixture on transpiration. Ohio Agr. Exp. Sta. Bimo. Bull. 18: 147-151, 1933.

(9) Kelley, V. W. Effect of certain hydrocarbon oils on the transpiration rate of some deciduous fruit trees. Ill. Agr. Exp. Sta. Bull. 353, 581-600, 1930.

The average results of the two trials with each species are given in Table 1. The data for potatoes are not given since the plants did not grow evenly during the experimental period.

TABLE 1.—Influence of Spray Materials on the Transpiration Rate and Water Requirements of Coleus, Tomato, and Cucumber Plants Grown in a Greenhouse Between January 10 and May 1, 1933

Treatment	Leaf area (one side) Sq. cm.	4-week total of transpiration Gm.	Transpiration (4th week only) Gm.	Transpiration per sq. cm. of leaf area (4th week only)	Green weight (tops only) Gm.	Dry weight (tops only) Gm.	Water requirements: Green-weight basis	Water requirements: Dry-weight basis
COLEUS								
30 per cent soil moisture								
Check	1212	2152	850	0.70	51	5.1	42.2	422
4-6-50 Bordeaux	487	1664	500	1.03	20	2.5	88.2	666
1-100 Volck, heavy	1120	1573	548	0.49	48	4.5	32.8	350
Bordeaux + oil, 1-1	900	1739	703	0.78	37	4.0	47.0	435
15 per cent soil moisture								
Check	1068	1305	500	0.47	34	4.0	38.4	326
4-6-50 Bordeaux	362	1089	306	0.85	14	2.0	77.8	545
1-100 Volck, heavy	995	1006	345	0.35	34	3.9	29.6	258
Bordeaux + oil, 1-1	665	1170	410	0.62	26	3.2	45.0	366
TOMATO								
30 per cent soil moisture								
Check	3305	4020	1635	0.49	214	23.0	18.8	175
4-6-50 Bordeaux	2628	4013	1758	0.67	189	17.1	21.2	235
1-100 Volck, heavy	2931	2420	913	0.31	191	16.4	12.6	147
Bordeaux + oil, 1-1	2760	3307	1384	0.50	181	17.0	18.3	194
15 per cent soil mixture								
Check	1956	2118	773	0.40	112	13.9	18.9	152
4-6-50 Bordeaux	1456	2025	804	0.55	90	10.3	22.5	197
1-100 Volck, heavy	1626	1316	485	0.30	91	9.6	14.5	137
Bordeaux + oil, 1-1	1791	1868	757	0.42	99	11.6	18.9	161
CUCUMBER								
30 per cent soil moisture								
Check	2938	3817	1550	0.53	182	18.0	21.0	212
4-6-50 Bordeaux	2587	3791	1545	0.60	153	15.0	24.8	253
1-100 Volck, heavy	3010	3090	1365	0.45	180	16.9	17.2	183
Bordeaux + oil, 1-1	2643	3650	1524	0.58	165	16.6	22.1	220
15 per cent soil moisture								
Check	1550	1940	762	0.49	87	11.0	22.3	176
4-6-50 Bordeaux	1178	1735	676	0.57	72	8.6	24.1	202
1-100 Volck, heavy	1363	1384	530	0.39	71	8.7	19.5	159
Bordeaux + oil, 1-1	1300	1552	614	0.47	78	9.6	19.9	162

One of the most noticeable points in these data is the difference in size (expressed as leaf area and green weight) between the plants receiving the different treatments. This is well illustrated in Figure 1, which shows representative plants at the end of one of the experiments on Coleus.

It will be noted that the plants were larger in the soil at a moisture content of 30 per cent than in that at 15 per cent. Of the plants in a given soil-moisture content the untreated ones were the largest, followed by those sprayed with oil emulsion. The plants treated with the half and half mixture were in all cases larger than those sprayed with bordeaux mixture alone. The difference in the size of the differently treated plants was not nearly so marked, however, in the case of tomatoes and potatoes. The stunting effect of bordeaux mixture on cucumbers, especially in the 15 per cent soil-moisture series, was very noticeable but was not as great as in the Coleus plants shown in Figure 1.

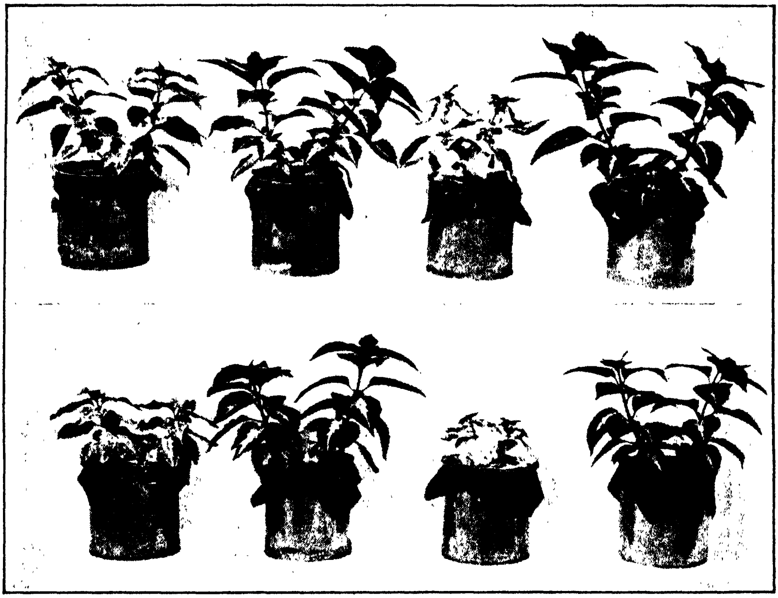

Fig. 1.—Relative growth of Coleus plants when treated with different spray materials and grown in soils at medium (top row) and low (bottom row) moisture contents. From left to right the plants received a 1-1 bordeaux-oil emulsion mixture, oil emulsion alone, bordeaux mixture alone, and no treatment.

In spite of the marked difference in size between the untreated and bordeaux-sprayed plants, the latter transpired nearly as much water as the former in most instances. This was due to the increase in the rate of water loss per unit of leaf area brought about by the presence of the bordeaux mixture on the leaves, as indicated in the fourth column of Table 1. The relative increases for the different species used are discussed further in connection with Table 2. The application of oil emulsion to the plants reduced the transpiration rate below that of the untreated plants in every instance and, strangely enough, reduced the growth slightly also. Growth and total transpiration were also reduced by applications of the half and half bordeaux-oil emulsion mixture, but the rate of water loss per unit of leaf area and the water requirement were very similar to those of the untreated plants. It may also be noted (column four of Table 1) that the transpiration rate per unit of leaf

area, for the fourth and final week of the experiments, was invariably less for the plants growing in the soil at 15 per cent soil moisture than for those at 30 per cent, as would be expected. An inspection of Columns five and six shows that bordeaux-sprayed plants (tops only) contained a higher percentage of dry matter than the untreated ones and that those sprayed with oil emulsion contained less. Also, plants growing in dry soil contained more dry matter per unit of green weight than did their duplicates in wetter soil.

Water requirement, as mentioned previously, represents the ratio between the amount of water transpired by a plant during its growth and its final dry weight. In this discussion the weight of the roots was disregarded, and thus the data given in the seventh and eight columns of Table 1 represent the results obtained when the total transpiration for 4 weeks was divided by either the green or dry weights of the tops only. Preliminary experiments by the authors indicated that bordeaux mixture increased the water requirement; whereas, oil emulsion decreased it (10). These results were duplicated in more detailed studies, the results of which are shown in the above table.

The water requirement of each of the three species used here was increased for both soil-moisture contents by the application of a 4-6-50 bordeaux mixture to the plants. It was decreased by the use of an oil emulsion (Volck, heavy, 1-100). When these two spray materials were mixed together in equal portions and the resulting mixture applied to the plants, their water requirement was but slightly, if at all, increased over that of untreated plants. These results, together with the data given in Column four of Table 1, indicate that the application of a spray which increases the transpiration rate will increase the water requirement; whereas, one which decreases the transpiration rate will decrease the water requirement. It may also be assumed that one which has little effect on the rate of water loss will probably bring about only little change in the water requirement.

The increase in the water requirement brought about by bordeaux mixture was similar for both of the soil-moisture contents used, as was the decrease caused by the application of an oil emulsion. Coleus showed the greatest increase and decrease in water requirement from the application of bordeaux mixture and oil emulsion, respectively; whereas, cucumber showed the least and tomato was intermediate. The fact that the water requirement of the untreated plants, as well as those of all treatments, was lower with the low soil-moisture content agrees with results reported for corn by Kiesselbach (3). A comparison of the water-requirement values for the two trials made with each species (the average values for which are given in Table 1) shows them to be higher in each case for plants grown in mid-winter than for those developing in early spring. Temperature values were similar throughout the experimental period. There was, of course, more sunshine in the spring. The evaporation rate was slightly higher in late winter and the relative humidity values were somewhat lower then also. Miller (4) has shown that water-requirement values are highest with high evaporation rates, and Montgomery and Kiesselbach (5) found that low water requirements accompany high humidity values. Thus, the lower water requirements of early spring may be explained by the fact that the evaporation rate was lower, the relative humidity higher, and the amount of sunlight greater than in mid-winter.

---

(10) Wilson, J. D. and H. A. Runnels. Some detrimental effects of spraying tomatoes with bordeaux mixture. Ohio Agr. Exp. Sta. Bimo. Bull. 18: 4-15, 1933.

An inspection of the data in the fourth and eighth columns of Table 1 indicates that the transpiration rates and the water requirements of the sprayed plants differ from those of the untreated plants in a very similar manner in each case. In Table 2 these variations are shown as percentages.

TABLE 2.—Effect of Spray Materials on the Transpiration from Equal Leaf Areas of Four Species Over a 7-day Period Preceding Harvest and on the Water Requirement of Three Species (Stated as the Percentage of Variation from that of Untreated Plants)

Treatment	Coleus		Tomato		Cucumber		Potato
	Transpiration	Water requirement	Transpiration	Water requirement	Transpiration	Water requirement	Transpiration
				30 per cent soil moisture			
4-6-50 Bordeaux.......	+47	+58	+37	+34	+13	+19	+ 9
1-100 Volck, heavy....	−30	−17	−37	−16	−15	−14	−13
Bordeaux + oil, 1-1...	+11	+ 3	+ 2	+11	+ 9	+ 4	0
				15 per cent soil moisture			
4-6-50 Bordeaux.......	+81	+67	+30	+30	+16	+15	+21
1-100 Volck, heavy....	−26	−20	−25	−10	−20	−10	− 8
Bordeaux + oil, 1-1....	+32	+12	+ 5	+ 6	− 4	− 8	+ 3

These data show that the variations for the two values are always in the same direction and often very similar in magnitude. The transpiration rates, however, were usually affected to a somewhat greater extent than the water requirements by the application of the spray materials used. This was especially true for the oil emulsion where the decrease in transpiration was greater than in water requirement. The transpiration rate of Coleus was most affected.

Wilson and Runnels (8) found the accelerating effect of bordeaux mixture on the transpiration rate to be greater on cloudy days than on sunny ones. The relative effects of bordeaux mixture and oil emulsion on sunny and cloudy days are shown in Table 3.

TABLE 3.—Relative Effects on Transpiration of Bordeaux Mixture and Oil Emulsion on Sunny and Cloudy Days (Stated as Percentages of Loss from Untreated Plants on Similar Days)

Weather	Average hours sunshine for 14 days	Evaporation from standardized white atmometers	Plants in 30 per cent soil moisture		Plants in 15 per cent soil moisture	
			Treated with bordeaux mixture	Treated with oil emulsion	Treated with bordeaux mixture	Treated with oil emulsion
	Hr.	*Cc.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Sunny.....................	6.5	26.2	85	78	74	92
Cloudy....................	0.9	18.2	94	69	88	86

The data of Table 3 show again that bordeaux mixture increases the transpiration rate more on cloudy days than on sunny ones. The effect of oil emulsion was, however, just the opposite since the transpiration rate was depressed to a greater extent on cloudy days. Bordeaux mixture, an accelerator of transpiration, was most effective in the soils containing the higher amount of moisture. This was also true of oil as a depressor of transpiration.

In an experiment designed to determine the relative effect of bordeaux mixture and oil emulsion on the rate of water loss from growing plants and abscised shoots, the severed tomato shoots of one experiment were dried for 12 hours on a rotating table and the losses in weight then compared with those of transpiration for the fourth week of the experiment. The variations from the untreated plants are shown in Table 4.

TABLE 4.—Relative Effect of Spray Materials on the Transpiration Rate of Growing Plants and the Drying of Abscised Shoots of Tomato (Stated as the Percentage of Variation from Untreated Plants)

Treatment	Transiration of growing plant	Desiccation of abscised shoot
30 per cent soil moisture		
4-6-50 bordeaux	+47	+63
1-100 Volck, heavy	—36	—40
Bordeaux + oil, 1-1	+ 9	+ 7
15 per cent soil moisture		
4-6-50 bordeaux	+37	+50
1-100 Volck, heavy	—31	—35
Bordeaux + oil, 1-1	0	+ 5

The relative effect of the three different spray materials on the rate of drying of abscised shoots is seen to be very similar to their relative influence on the transpiration rate of the growing plants. This has been found to be true in a large number of other experiments conducted by the authors; and preliminary tests performed by dipping cut shoots in various spray materials and then studying the relative rates of water loss from the shoots have furnished reliable information concerning the effect of these materials on the transpiration rates of plants treated with them.

SUMMARY

The water requirement of plants, or the ratio between the weight of water absorbed and the dry matter produced, varies with variations in the environmental complex in which they develop. Thus, either bordeaux mixture or oil emulsion, both of which alter the effect of certain environmental factors when they are applied to a plant, should also affect the water requirement. To determine the extent of this influence plants of Coleus, tomato, cucumber, and potato, grown in one-gallon tinned containers, were sprayed with a 4-6-50 bordeaux mixture, a 1-100 mixture of Volck spray oil in water, and with a half and half mixture of these two materials, and their total water losses and final dry weights were then compared with those of untreated plants. The plants were grown in soils held at 50 and 25 per cent of moisture on the basis of their water-holding capacity, or 30 and 15 per cent on a dry-weight basis.

Bordeaux mixture increased the water requirement of Coleus, tomato, and cucumber at both soil-moisture contents. The water requirement for potato was not determined because of the uneven growth of the plants during the experimental period. The rate of water loss from equal areas of leaf surface was greater from plants of all four species when treated with bordeaux mixture than it was from untreated ones. The oil emulsion (Volck, heavy, 1-100) decreased the transpiration rate and the water requirement below that of untreated plants. When the two spray materials were mixed together and the mixture then placed on the plants, the water requirement and the transpiration rate were but little affected, being only slightly increased over the checks in most instances. Plants grown in early spring had lower water requirements than those grown in mid-winter.

Bordeaux-sprayed plants were smaller at harvest than untreated ones in all cases. The stunting effect was usually most marked in the series at 15 per cent soil-moisture content. Oil-sprayed plants were slightly smaller than those receiving no treatment and those sprayed with the half and half mixture were intermediate in size between those treated with bordeaux mixture and with oil emulsion. The plants treated with bordeaux mixture contained a higher percentage of dry matter than was the case with either of the other two treatments. Of the three species for which the water requirements were determined, Coleus was most affected by the application of both bordeaux mixture and oil emulsion, cucumber was the least, and tomato was intermediate.

Bordeaux mixture was more effective in increasing the transpiration rate over that of the untreated plants on cloudy days; whereas, oil emulsion was more effective in depressing it on those days.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

During September, October, and November there was little change in the wholesale price level. The prices received for farm products, however, declined during August and September. The decline in business activity which began in July continued up to the middle of November. Although the purchasing power of the Ohio farm dollar was lower in November than in July, it was still 30 per cent higher than in March and 17 per cent higher than in November 1932.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U.S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914....	99	100	101	102	102	102	105	107
1915........	102	101	106	100	103	107	106	110
1916........	125	114	123	117	113	113	121	121
1917........	172	129	150	176	140	119	182	198
1918........	192	160	178	200	175	131	203	243
1919........	202	185	205	209	204	135	218	266
1920........	225	222	206	205	236	159	212	242
1921........	142	203	156	116	164	134	132	136
1922........	141	197	152	125	145	124	127	136
1923........	147	214	153	135	166	122	134	149
1924........	143	218	154	134	165	118	133	150
1925........	151	223	159	146	165	110	159	164
1926........	146	229	156	136	170	105	155	176
1927........	139	231	154	131	173	99	147	163
1928........	141	232	156	139	169	96	154	147
1929........	139	236	155	138	169	94	151	161
1930........	126	226	146	117	154	90	128	130
1931........	107	207	129	80	120	82	89	93
1932........	95	178	110	57	92	70	63	67
1932								
January...	98	191	115	63	100	....	69	81
February..	97	189	114	60	....	....	64	68
March.....	96	189	112	61	....	70	64	67
April......	95	183	111	59	94	....	64	65
May.......	94	177	109	56	....	....	61	63
June.......	93	174	108	52	....	....	59	61
July.......	94	171	107	57	90	....	63	67
August....	95	172	107	59	....	....	66	73
September.	95	177	106	59	....	....	64	67
October....	94	177	105	56	84	....	61	68
November.	93	171	104	54	....	....	61	56
December..	91	170	103	52	....	....	60	96
1933								
January...	89	164	102	51	75	....	55	62
February..	87	164	101	49	....	....	53	61
March.....	88	163	100	50	....	59	53	54
April......	88	165	101	53	70	....	59	60
May.......	92	169	102	62	....	....	71	72
June.......	95	172	103	64	....	....	70	82
July.......	100	176	105	76	73	....	83	96
August....	101	176	112	72	....	....	79	93
September.	103	179	116	70	....	....	79	78
October....	103	....	116	70	77	....	78	82

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Ohio Agricultural Experiment Station

WOOSTER, OHIO, U. S. A.

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Free Bulletin

C. G. Williams

Director

Unpruned apple trees come into bearing earlier than pruned ones as shown in a Station orchard. Those to left are unpruned. Moderate pruning, however, is advised for properly shaping the trees

THE VALUE OF CLOVER AS A PURVEYOR OF NITROGEN TO OTHER CROPS

CHAS. E. THORNE

The fact that clover has a beneficial effect upon other crops following it in rotation has been recognized for centuries. Near the end of the Nineteenth Century it was demonstrated that this benefit is largely due to the conversion of atmospheric nitrogen into a form available to farm crops by the action of organisms inhabiting the nodules found on the roots of clover and other leguminous plants.

This demonstration was the outcome of elaborate chemical and biclogical research. What it means in the practical management of the farm can only be determined under the conditions of water supply, temperature, and climatic change that prevail in the open field, together with the various factors involved in tillage and crop rotation. On the glaciated silt-loam soil, derived chiefly from Waverly sandstones, of the Ohio Agricultural Experiment Station at Wooster, corn, oats, and wheat have each been grown separately in continuous cropping and have also followed each other in the order given in a 5-year rotation of corn, oats, wheat, clover, and timothy for the 40 years 1894-1933, each crop being grown every year in both tests.

In the rotative cropping half the land has been limed for every corn crop since 1900, the liming material being caustic lime used at the rate of one ton per acre for the first rotation and finely ground raw limestone at about a ton and a half per acre since.

The continuously grown corn has received liming on half the land equivalent to that given the rotated corn. The oats grown continuously have had one liming on half the land (in 1911); whereas the wheat grown continuously has had several limings spread over all the land.

At the Northeastern Experiment Farm of the Ohio Station, located at Strongsville, Cuyahoga County, on a soil derived from an argillaceous shale of the Waverly series, slightly modified by glaciation, the rotation described above has been duplicated since 1895, except that the timothy crop after repeated failures was replaced from 1915 to 1923 by soybeans grown for hay and in 1924 and since by sweet clover plowed under, the order of cropping being changed to bring the soybeans or sweet clover between the oats and wheat.

In this test the liming of half the land was begun at the same time and rate as at Wooster; whereas, on the other half, finely ground raw phosphate rock was spread at the rate of one ton per acre during two rotations, after which all the land was limed alike.

At the Pennsylvania State College Experiment Station, located on a residual limestone soil, a 4-year rotation of corn, oats, wheat, and clover was begun in 1882. Forty years of this test are summarized in Bulletins 175 and 264 of that station.

At the Experiment Station of the University of Missouri, College of Agriculture, located at Columbia, corn, oats, wheat, clover, and timothy have been grown separately in continuous culture and following each other in various rotations since 1888 on a dark, brownish-gray silt loam derived from the Kansas drift. The soil is underlaid with limestone at depths of 20 to 35 feet, but

the surface shows considerable acidity. The results of this work for the first 30 years are given in Bulletin 182 of that station. Later results have not yet been published but are described as showing no marked variation from those published.

In Table 1 are shown the average yields of total produce—grain and straw or hay—obtained in these experiments from the land receiving no treatment except the liming. The yields from limed and unlimed land were averaged, together with the gains for the rotative over the continuous cropping and the annual yield of clover hay as grown in the rotative cropping.

TABLE 1.—Yields on Unfertilized Land in Continuous Cropping and Gains for Rotation Compared with Yields of Clover

Total annual produce per acre

Station	Cropping	Total produce: Corn	Oats	Wheat	Total gain	Clover yield
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Wooster	Continuous	1,914	1,400	1,382		
	Rotative	3,276	2,208	1,810		
	Gain, lb.	1,362	808	428	2,598	2,353
	Gain, pct.	71	58	31		
Strongsville	Rotative	3,670	2,495	2,141		
	Gain, lb.	1,756	1,095	759	3,610	2,041
	Gain, pct.	90	78	55		
State College	Rotative	4,054	2,184	1,875		
	Gain, lb.	2,140	784	493	3,417	2,189
	Gain, pct.	110	56	35		
Columbia	Continuous	3,515	1,640	1,811		
	Rotative	4,804	2,590	3,120		
	Gain, lb.	1,289	950	1,309	2,648	2,173
	Gain, pct.	36	58	72		

In this table the rotated crops at Strongsville and State College are compared with those grown continuously at Wooster, as they have not been grown separately in these tests. At Columbia the continuously grown crops furnish a direct comparison in that test.

The gains for rotation are shown in pounds per acre and in percentages of the continuous yields. At Wooster a crop of timothy is grown between the clover and the corn, and at Columbia two crops of timothy intervene. At Strongsville the corn has been grown on clover sod since 1915; previous to that time the corn followed timothy. At State College corn has followed clover throughout the 40 years.

The percentage figures show that there has been a drop in the potential yield of corn with every removal from clover sod. The superior yield of oats at Strongsville is probably due to the fact that oats thrive better in northern latitudes.

Wheat grown farthest from the clover shows the lowest percentage gain, except at Columbia; but two of the six crops of wheat grown in this test have followed clover instead of oats, averaging 36 bushels per acre as compared with 12 bushels for the average of the other four crops.

In the Columbia rotation only one tract of land is employed; consequently, seasonal conditions have been a much larger factor in the outcome than in the other tests in which each crop has been grown every season.

The percentage figures show a consistent tendency to diminishing yields as distance from the clover crop increases, the apparent contradictions in the Missouri test being fully explained by irregularities in the rotation.

The table shows that in every comparison the sum of the gains of the three grain crops in the rotation over the yields of the same crops grown continuously is much greater than the weight of the clover hay, thus showing that, if we may credit these gains to the clover, the hay value of that crop is less than half its total value; that the clover is entitled to this credit is shown by the decreasing yield in long rotations as distance from the clover crop increases.

CLOVER VERSUS FERTILIZER NITROGEN

One plot in the continuous cropping has received on each crop a fertilizer made up of 160 pounds superphosphate, 100 pounds muriate of potash, and 160 pounds nitrate of soda per acre per annum; the sum of the dressing for the three crops, therefore, was 480 pounds superphosphate, 300 pounds muriate of potash, and 480 pounds nitrate of soda.

In the rotative cropping at Wooster and Strongsville one plot has received 80 pounds superphosphate and muriate of potash each on corn and oats and 160 pounds superphosphate with 100 pounds muriate of potash on wheat but has had no carrier of nitrogen except the clover. The 40-year outcome is shown in Table 2 as averaged for limed and unlimed land.

TABLE 2.—Comparison of Clover with Fertilizer Nitrogen

Treatment	Annual yield per acre		
	Corn	Oats	Wheat
	Bu.	*Bu.*	*Bu.*
Grown continuously with minerals and nitrogen	36.0	39.6	19.1
Grown in rotation with minerals only:			
Wooster	42.8	44.2	21.4
Strongsville	38.0	49.7	22.6

Since in the continuous cropping each crop has received 160 pounds of nitrate of soda annually whereas in the rotative cropping the effect of one year's growth of clover has been distributed over the three grain crops, it is evident that the effect of the clover has been much greater than that of 480 pounds of nitrate of soda.

As stated above, the corn following immediately after the clover has shown the greatest effect from the clover. In both the continuous and rotative cropping corn has been grown on unlimed and limed land with the outcome shown in Table 3 (here the yields of corn are shown separately for limed and unlimed land instead of being averaged as in Table 2).

Table 3 shows that on the unfertilized land lime alone has raised the yield from 10.62 bushels to 13.21 bushels per acre for the entire period, a gain of about 20 per cent; whereas rotation alone has increased it to 20.84 bushels, a gain of 96 per cent, and lime and rotation combined to 30.19 bushels, a gain of 180 per cent.

On the fertilized land liming alone has made very little difference in yield of the continuously grown corn, the nitrate of soda having to some extent

reduced the demand for lime; but the rotated corn shows a marked increase in yield, the combination of lime and clover producing one-third more grain than that of lime and nitrate of soda, notwithstanding the smaller allowance of the mineral fertilizers.

TABLE 3.- -Yields of Corn in Continuous and Rotative Cropping at Wooster. 1894-1932*

Cropping	Unfertilized land: Annual yield per acre			Fertilized land: Fertilizers per acre per annum			Fertilized land: Annual yield per acre		
	Grain Bu.	Stover Lb.	Total Lb.	Super-phosphate Lb.	Muriate of potash Lb.	Nitrate of soda Lb.	Grain Bu.	Stover Lb.	Total Lb.
Unlimed land									
Continuous....	10.62	993	1,736	160	100	160	35.68	2,120	4,617
Rotative......	20.84	1,296	2,755	80	80	....	37.14	1,892	4,492
Gain.........	10.22	303	1,019	....	....	....	1.46	—228	—125
Limed land									
Continuous....	13.21	1,168	2,090	160	100	160	36.26	2,033	4,571
Rotative.......	30.19	1,684	3,797	80	80	....	48.55	1,871	5,270
Gain.........	16.98	519	1,707	....	....	....	12.29	162	699

*Yield data for 1933 are not yet available.

That a part of the effect of nitrate of soda has been due to its neutralizing effect on this acid soil is shown in another part of this rotation experiment, where a mineral fertilizer, when reinforced with nitrate of soda, has produced 6 bushels more corn per acre over the entire period than when reinforced with the same quantity of nitrogen in sulfate of ammonia; however, after full allowance is made on this point, it is evident that the clover has served as a very efficient purveyor of nitrogen to the corn crop.

APPLICATION

East of the approximate longitude of Columbus the surface rocks of Ohio are chiefly sandstones and shales; west of that longitude they are chiefly limestones. The soils overlying the sandstones are generally deficient in lime, a deficiency which has been steadily increasing during the present century, making it more and more difficult to grow satisfactory crops of clover. The average contour over the sandstones is more rolling than over the limestones, thus increasing the tendency toward erosion; the consequence is that less clover is grown in eastern Ohio and the timothy is allowed to stand longer. The Census statistics for 1920 show nearly twice as much timothy and less than half as much clover per hundred acres in farms in the eastern as in the western half of the State, with the result that crop yields are lower and expenditure for fertilizers larger.

Clover must have lime, and the cereal crops must have nitrogen. With liming, clover may be grown quite as successfully over the sandstones as over the limestones, and on most farms the cost of liming will be more than recovered in the increase in crop yield due to the nitrogen which liming will enable clover to furnish at a far lower cost than that at which it can be purchased in the fertilizer sack.

THE TIME OF CUTTING THE TRUE CLOVERS

C. J. WILLARD, J. S. CUTLER, AND J. B. McLAUGHLIN

Although red clover is the most important legume in the northeastern quarter of the United States, there are no systematic time-of-cutting experiments with red clover recorded in the agronomic literature of the past 20 years or more. This does not mean, however, that all of the questions involved in cutting medium red clover and other true clovers have been experimentally answered.

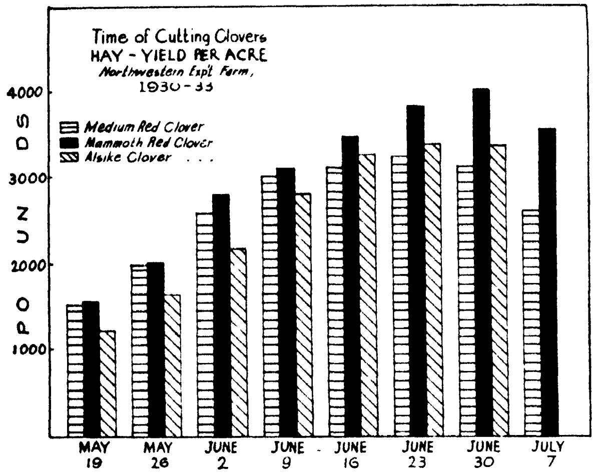

Fig. 1

In times like the present, it seems desirable to direct research somewhat more toward discovering the best ways of doing those things that are essential in producing the crop and somewhat less toward those things which require cash outlay. When the Northwestern Experiment Farm[1] was first established, the time of cutting the true clovers was made an important project. In each of 4 years beginning in 1929 three of the true clovers (medium or double-cut red clover, mammoth or single-cut red clover, and alsike clover) were sown in early oats, and the yields taken the following year. The stubble was clipped in late August of 1932 but left untouched in the 3 preceding years. Duplicate, and sometimes triplicate, plots were sampled and cut on each date indicated in Table 1. Yields were obtained by harvesting four representative square-yard samples from each plot. The data on protein content are averages or duplicate samples in each year. In the second cutting, yields of hay were determined at approximately full bloom, and the seed yields at what was judged to be the best date. No seed was produced in the second cutting in 1933; hence, the seed yields are only a 3-year average.

[1]The Northwestern Experiment Farm, located at Holgate, Henry County, about 50 miles southwest of Toledo, is conducted cooperatively by the Division of Forage Plants and Diseases, U. S. Department of Agriculture, Washington, D. C., and the Department of Agronomy, Ohio Agricultural Experiment Station. The soil on this farm is known as Brookston clay, a naturally fertile, dark-colored soil of glacial limestone origin.

All of the four seasons involved in the test, and especially 1930 and 1933, were drier than normal during the growing season of the clovers. The 4-year average total deficiency for the months of May, June, July, and August was over 4 inches of rainfall; consequently, the acre yields are lower than this soil type would usually produce. There is reason to believe that the relative yields at the first cutting on the different dates are fairly representative of those that would have been obtained had more seasons been averaged.

TABLE 1.—Time of Cutting the True Clovers, Holgate, Ohio

Date of making first cutting	Yield of hay per acre, first cutting Av. 4 yrs. 1930-1933 Lb.	Protein in hay, first cutting Av. 3 yrs. 1931-1933 Pct.	Protein per acre, first cutting Av. 4 yrs. 1930-1933 Lb.	Yield per acre, second cutting Av. 4 yrs. 1930-1933 Lb.	Yield of seed per acre, second cutting Av. 3 yrs. 1930-1932 Lb.
Medium Red Clover					
May 19—Buds	1530	22.4	343	960	40
May 26—First flowers	1980	21.1	418	1080	92
June 2—30% bloom	2580	18.7	482	1020	99
June 9—65% bloom	3010	15.9	478	980	99
June 16—Full bloom	3100	14.9	462	910	106
June 23—25% brown	3220	13.5	435	860	64
June 30—60% brown	3120	12.7	396	850	49
July 7—Too ripe	2610	12.1	316	660	31
Not cut—seed in first crop	....	....	....	....	27
Mammoth Red Clover					
May 5	1200†	24.0‡	288	2620†	34
May 12	1380†	24.0‡	331	2420†	34
May 19	1570	23.8	374	1140	42
May 26	2010	21.9	440	800	29
June 2—Buds	2790	18.8	524	640	24
June 9—First flowers	3070	17.3	531	580	12
June 16—30% bloom	3460	15.9	550	150	*
June 23—Full bloom	3800	14.4	547	....	....
June 30—Some brown	4000	13.6	544	....	....
July 7—35% brown	3540	12.8	453	....	....
Not cut—seed in first crop	....	....	....	....	46
Alsike Clover					
May 19—Buds	1220	23.7	289	230	6
May 26—15% bloom	1650	21.6	356	220	5
June 2—50% bloom	2160	18.2	393	250	....
June 9—Full bloom	2810	16.0	450	200	6
June 16—Many brown	3250	14.8	481	....	*
June 23—Mostly brown	3360	13.4	450	....	....
June 30—Nearly ripe	3320	13.4	445	.....	....
Not cut—seed in first crop	....	....	....	....	155

*No second crop when cut later.
†Av. 3 years only—1930-1932.
‡Av. 2 years only—1931-1932.

The bloom indications given in Table 1 are only approximate. They differed each year and represent field notes of appearance and not counts of bloom. Nevertheless, they give about as accurate a description of the average condition of the plots as can be given by bloom designations, which are always more or less indefinite. It is particularly unsatisfactory to designate the stage of maturity of alsike clover by bloom, since it continues to grow and bloom for a considerable period. At Holgate, and in Ohio generally, alsike shows an amount of bloom which might be called "full bloom" somewhat earlier than red clover, and yet, as the data show, it continues growing for a longer period than

red clover. Since the plots were cut at 7-day intervals, June 16th is given as "full bloom" for red clover, but it is probable that the average full-bloom date would be more accurately given as June 12 or 13. Similarly, full bloom for mammoth was probably a few days later than June 23; consequently, while it appears from the table that only one week elapsed between full bloom for medium red clover and mammoth red clover, there was actually a difference of 10 or 12 days in the maturity of these two strains.

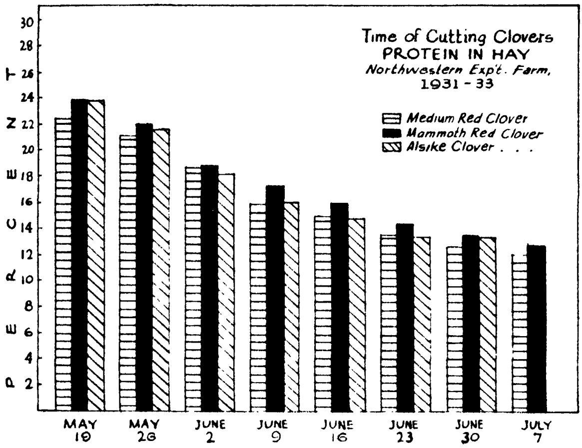

Fig. 2

The yield (Fig. 1) of medium red clover reached practically its highest point at June 9 and continued with no significant change in yield until after June 30, when, apparently, such sources of loss as insects, leaching, and dropping of leaves resulted in greater losses than were replaced by growth. The yield of alsike clover did not reach a maximum quite as early as did red clover, but there was no practical increase after June 16. It should be borne in mind that these yields were obtained from square-yard samples, and, hence, all the material was harvested. Alsike lodges so badly that in field practice much of it is left on the ground; thus, the amount which would have been obtained by the mowing machine was probably at a maximum by June 9. As would be expected from its later maturity, mammoth clover did not reach its maximum yield until late in June.

In protein content (Fig. 2), all three clovers showed a rapid and fairly steady decrease throughout the period studied. The protein contents of medium red clover and alsike were nearly identical throughout the period. Mammoth red clover, as might be expected from its later maturity, was slightly higher in protein than either of the others at all dates of cutting. This was true for each of the 3 individual years.

Since clover hay is usually valued especially for its protein content, the yield of protein per acre (Fig. 3) is particularly significant. Medium red clover gave its maximum yield of protein during the first 2 weeks of June. Even with mammoth red clover, the total protein did not increase greatly after June 2, although the highest yield of protein was reached on June 16. June 16 also marked the highest yield of protein from alsike, but the difference was not great from June 9 to June 30.

Since the first cutting of medium red clover was made at progressively later dates in each year succeeding the first, there is a tendency for the yield of corresponding second cutting to decrease, but the dry seasons during the test render any conclusions concerning second-cutting yields uncertain. Mammoth red clover makes very little second cutting and none if cut late. Study of the recovery of mammoth clover after clipping showed that the crops produced, after the May 5 and May 12 clippings, were made by stems which were not tall enough on those dates to be cut by the mower. This accounts for the abrupt drop in second-cutting yields as soon as the stands had grown enough so that all stems were cut by the mower.

There was practically no useful second cutting of alsike at any time in any year, but the plants did not die even in the driest years (1930 and 1933). In general, alsike deserves its reputation for making only one cutting, but rainfall is an important factor in determining this; for example, at Columbus in 1932, with abundant summer rainfall, the second cutting of alsike averaged 2220 pounds per acre on August 13, following large first cuttings made May 24 to June 14.

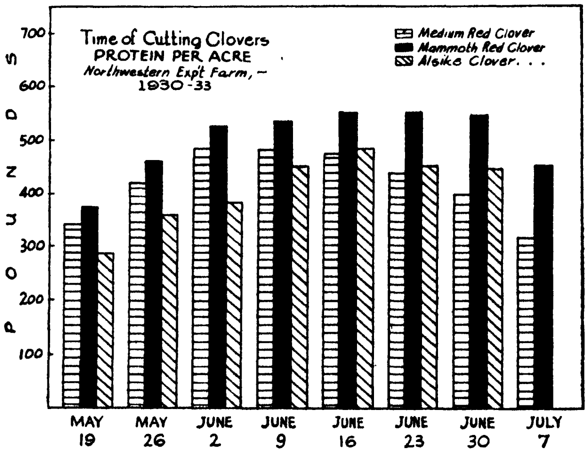

Fig. 3

The seed yields of medium red were not large in this experiment. They showed a marked and consistent tendency to decrease with each later cutting date when the first cutting was made after June 16. This tendency was present in each of the 3 years of the experiment in which any seed was produced.

SUGGESTIONS FOR CUTTING CLOVERS

Taking all factors into account, it seems that for best results in northern Ohio medium red clover should be cut the second week of June, with the first week preferable to the third week insofar as quality of product is concerned. This is the same period which long-time experiments have shown to be most favorable for making the first cutting of alfalfa in this section. The actual practice of farmers is to cut red clover during the fourth, or occasionally the third, week of June. It seems clear that a modification of this practice would

produce a much higher quality of red clover hay for feeding without decreasing the yield, as well as decidedly increasing the chance of obtaining a profitable seed crop, pasture, or second cutting of hay.

Alsike clover should also be cut during the second week of June, if a good quality hay is to be obtained.

Mammoth red clover should be cut for hay during the third and fourth weeks of June. The recommendation has been made to clip mammoth red clover which is intended for seed, in order to reduce the amount of straw to be handled. It seems clear from these experiments that such clipping is decidedly unsafe after May 20, and it probably reduces the seed crop whenever it is done.

Rolling the first cutting of mammoth when left for seed was also included in these trials. There was no indication that the practice affects the actual yield of seed.

TABLE 2.—Time of Cutting Clovers, Columbus

Date of cutting	Medium red clover		Mammoth red clover		Alsike clover	
	Yield* per acre	Protein† in hay	Yield‡ per acre	Protein§ in hay	Yield‖ per acre	Protein in hay
	Lb.	*Pct.*	*Lb.*	*Pct.*	*Lb.*	*Pct.*
May 25	....	....	....	....	2830	20.8**
June 1	3620	16.8	4240	18.4	3100	17.3***
June 8	3800	14.8	4440	17.3	3210	15.5*
June 15	3810	14.2	4990	15.5	3160	14.7*
June 22	....	....	4710	14.7	....	....

*Four years: 1929-30, 1932-33. †Five years: 1929-33. ‡Two years: 1932-33. §Three years: 1931-33. ‖Two years: 1930, 1932. **Two years only. ***Three years.

These conclusions are supported by less extensive experiments conducted by the senior author at Columbus, a summary of which is given in Table 2. There is some indication that the most favorable cutting dates are somewhat earlier at Columbus than at Holgate.

PROPORTION OF PROTEIN NEEDED IN THE GRAIN MIXTURE FED WITH PASTURE. III

A. E. PERKINS

In continuing work previously reported in the Bimonthly Bulletin[1], two grain mixtures of different protein content were compared for dairy cows on pasture from June 1 to September 30, 1933. The same general method of procedure was employed as in previous grazing seasons.

The previous work showed that a mixture consisting of one-half corn and one-fourth each of oats and wheat bran, a mixture analyzing about 12 per cent total protein, gave, in one season when pasture conditions were good, production fully equal to another mixture consisting of corn one-third and oats, bran, corn gluten meal, and linseed oilmeal each one-sixth. The protein content of the latter mixture was 20 per cent. In the second season, using the same grain mixtures, when pasture conditions were less favorable, there was some extra production from the higher protein feeding but the additional returns were not sufficient to pay for the extra cost of the feed. This extra cost, at prices then prevailing, amounted to about $2.00 per cow for the pasture season.

In the 1933 work, 16 cows of the Experiment Station herd were fed the two experimental grain mixtures. They were divided into two groups as nearly alike with respect to breed, age, stage of lactation, and productive capacity as possible. Only six cows in one group and five in the other, however, finished the season without the occurrence of some incident which made the use of their records in the final comparison inadvisable. Most of the cows were past the peak of production and approaching the end of lactation. The average daily production was 24.4 pounds on the basis of 4% milk.

All the cows had been on pasture for about 2 weeks before the experiment was started on June 1. The condition of the pastures was good during the early part of the season, but the midsummer drouth began earlier than usual and lasted until mid-August. During July and August some soybean hay was fed in addition to the pasture and the experimental grain mixtures. Approximately 39 per cent of the requirements, according to the average level of the Morrison standard, was being supplied in the form of hay and grain at this time. During September the cows were grazed on a meadow containing considerable alfalfa, and the soybean hay feeding was discontinued.

The low-protein grain consisted of 49.5 per cent each of corn and oats and 1 per cent of feeding bonemeal, the purpose of the latter being to guard against a deficiency of phosphorus, which in the ordinary ration is supplied to a large extent by bran or by one of the oilmeals. This mixture carried 11 per cent of total protein. The high-protein grain mixture contained 40 per cent each of corn and oats and 10 per cent each of cottonseed meal and linseed oilmeal, carrying about 16 per cent of total protein. As in the previous experiments the two groups of cows were alternated in reverse order from one of these grain mixtures to the other by periods of one month each.

[1]May-June, 1928, and May-June, 1929.

The plan of the experiment called for feeding the respective grain mixtures at the same rate, according to production, and also for supplying any supplementary feed (such as hay or silage) in the same amount for both groups. Nevertheless, somewhat more of both hay and grain was consumed in connection with the high-protein ration, as shown in Table 1. The production of 4% milk by each group for each monthly period is also shown in this table. The net gain or loss in liveweight for each group during the month is also shown in the last column. All the feeding and production figures for the months of June and September were obtained by multiplying the actual values by 1.033 to make them comparable with the longer months of July and August.

TABLE 1.—Monthly Feed, Production, and Liveweight Record, by Groups, 1933

Group	Month	Grain mixture	Feed consumption		Production computed to 4% milk	Gain or loss in liveweight
			Grain	Hay		
			Lb.	*Lb.*		
I	June	High-protein	1143.5	None	5625.8	—124
I	July	Low-protein	1256.0	256.6	4865.9	— 25
I	Aug.	High-protein	1169.0	507.6	4338.7	—214
I	Sept.	Low-protein	972.4	None	4166.7	+ 28
II	June	Low-protein	780.7	None	4283.7	—139
II	July	High-protein	1040.0	205.6	3797.5	+ 59
II	Aug.	Low-protein	941.6	342.4	3065.9	—162
II	Sept.	High-protein	837.1	None	3197.7	+ 73

TABLE 2.—Summary of Milk Production and Feeding

Period	Production of 4% milk	Feeding	
		Grain	Hay
	Lb.	Lb.	Lb.
High-protein feeding			
June-July	9,423.3	2,183.0	205.6
August-September	7,536.4	2,006.0	507.6
Total	16,959.7	4,189.0	713.2
Low-protein feeding			
June-July	9,149.6	2,036.7	256.6
August-September	7,232.6	1,914.0	342.4
Total	16,382.2	3,950.7	599.0
Separate comparison for the months of July and August			
High-protein feeding	8,136.2	2,209.0	713.2
Low-protein feeding	7,931.8	2,197.6	599.0
Excess on high-protein feeding	204.4	11.4	114.2
Total excess on high-protein feeding	577.5	239.0	114.2

In Table 2 these figures are grouped according to the grain ration fed. The excess of milk production and of hay and grain consumption for the high-protein periods is shown in the last line of this table. The relative results are

seen to be much the same whether the totals for the season or 2-month periods taken separately are compared as shown at the bottom of the table for July and August. The surplus of hay and grain consumed during the high-protein periods contained, according to average values, 242.8 pounds of digestible nutrients. For a half month before starting on pasture in the spring and for a like period after winter feeding was resumed in the fall, the cows of this group produced an average of 1.67 pounds of 4% milk for each pound of total digestible nutrients supplied in their ration. At this same rate the extra hay and grain fed would account for 405.5 pounds of the extra production, leaving 172 pounds apparently due to the superiority of the higher protein grain. This is slightly more than one per cent of the production based on the lower protein feeding. This small difference in production clearly would not have repaid the extra cost of the high-protein grains as ascertained at the time of our previous experiments in 1926 and 1928, when price relations were more nearly normal (approximately $2.00 per cow per season).

TABLE 3.—Chicago Prices for Grains and Feeding Stuffs; Also Prices at the Farm for Corn and Oats*

Summers of 1932 and 1933

	Chicago prices				Ohio farm prices	
	No. 2 Yellow corn	No. 3 White Oats	Cottonseed meal 41% protein	Linseed oilmeal 34% protein	Corn	Oats
	Cts. per bu.	*Cts. per bu.*	*Dol. per ton*	*Dol. per ton*	*Cts. per bu.*	*Cts. per bu.*
June 1932	31	21	16.50	22.90	26	19
July 1932	33	18	17.55	22.80	26	18
Aug. 1932	33	17	21.65	23.90	28	17
Sept. 1932	30	17	21.45	24.55	28	16
Average	31.75	18.25	19.29	23.54	27	17.5
June 1933	46	30	23.30	26.40	44	27
July 1933	57	39	33.50	35.45	60	43
Aug. 1933	54	36	28.90	36.65	56	34
Sept. 1933	49	35	24.20	34.40	52	34
Average	51.5	35	27.47	33.22	53	34.5
Average price per ton, during summer						
1932	$11.34	$11.41	$19.29	$23.54	$ 9.64	$10.94
1933	18.39	21.86	27.47	33.22	18.93	21.56

*From "Crops and Markets". Monthly Publication, U. S. Department of Agriculture.

In Table 3 is presented a price study of the grains used during the 1933 season. Prices for 1922 are also given for comparison. Both the Chicago price and the average Ohio farm price are given. The prices of grains are seen to have undergone very striking fluctuations, especially during the summer of 1933. Although the fluctuations on the feeding stuffs' market were less marked than those of the grains, they were far greater than commonly occur under normal price conditions. The difference in price between the farm grains and the high-protein feeding stuffs was also much less than usual. With the corn and oats figured at farm prices (plus 10 cents per cwt. grinding charges) and the cottonseed meal and linseed oilmeal at Chicago prices (plus an allowance of $5.00 per ton or 25 cents per cwt. for freight and dealer's profit), the cost of the 3950 pounds of grain mixture fed to each group, after deducting the

excess fed with the high-protein grain, was $48.98 for the high-protein mixture and $44.12 for the other, a difference of $4.86. This difference is equivalent to a cost of $2.80 per cwt. for the 172 pounds of extra milk produced by the high-protein feeding. This is much more than the milk would have brought on the market at that time. Thus, while in amount of actual milk production the results favor the higher protein grain by slightly more than one per cent, the financial advantage, on the other hand, is in favor of the lower protein grain even under the unusual price relations of 1933. Under normal price relations the financial advantage would have been more strikingly in favor of the lower protein grain.

The liveweight figures (Table 1) show a total net loss of 181 pounds for all cows during the periods of high-protein grain feeding. They also show a somewhat greater loss of 244 pounds during the periods when the low-protein grain mixture was being fed. This loss is small and was not noticeable in the appearance of the cows, all of which were in excellent condition at the beginning of the pasture season and would probably have received the same score at the end of the season. Just what real significance these liveweight data might have if applied to the probably more common condition where the cows are thin when turned to pasture is difficult to predict accurately; however, it seems to constitute a minor argument favoring the higher protein grain.

No bran was used in the 1933 grain mixtures. Since bran is sometimes considered a relatively expensive high-protein feed, a good grade of feeding bonemeal was used instead as a source of phosphorus in the low-protein ration. One per cent of bonemeal supplied practically the same amount of phosphorus as 10 per cent of bran and made the phosphorus content of the low-protein grain slightly higher than that of the other. The question arises, "Which was more economical to use, bran or bonemeal?" We do not have a direct experimental comparison of these two grain mixtures but assume that their relative efficiency would follow the digestible nutrients content. Bran contains four-fifths as much digestible nutrients as a mixture of corn and oats; thus, a mixture containing 10 per cent of bran will have a digestible nutrient content 2 per cent lower than corn and oats alone. Bonemeal contains practically no digestible nutrients other than the minerals calcium and phosphorus; hence, the addition of one per cent of this material reduces the digestible nutrients of the mixture one per cent below the level of the original corn and oats. This makes approximately a one per cent difference in digestible nutrients in favor of the bonemeal mixture. At 1933 prices ($1.58 per cwt. for bonemeal and about $1.10 per cwt. for both the corn-and-oats mixture and the wheat bran), there was practically no difference between the bran and the bonemeal mixtures in the cost of providing digestible nutrients and phosphorus.

Some of the outstanding points of comparison or difference between this and our previous pasture experiments are as follows:

1. The pasture conditions were somewhat like those of the 1928 season. A similar, small production advantage is shown for the high-protein grains; whereas the economic advantage is in the opposite direction.

2. The high-protein grain mixture used in the present experiment contained only 20 per cent of high-protein products, instead of the 33⅓ per cent used in the previous experiments, and carried 16 per cent instead of 20 per cent of total protein.

3. The low-protein ration, due to the omission of the bran, was also somewhat lower in protein than that previously used (11 per cent instead of 12 per cent). The range of protein content between the experimental grain mixtures

was thus reduced from 8 per cent to 5 per cent. This tended to reduce the price difference between the two mixtures, and it was also further reduced by the unusually small price differences between protein concentrates and farm grains during this season.

4. In spite of all these levelling influences, if we overlook the small difference in liveweight losses, the low-protein, or farm-grown, grains held the financial advantage under the conditions of the experiment.

5. With other conditions the same, if the cows had been near the beginning of the milking period and producing more heavily, the results would probably have been somewhat more favorable to the higher protein grain.

In view of the present experiment and of those previously reported, the conclusion seems justified that, under ordinary pasture conditions as described, the liberal use of high-protein products in the supplemental grain ration is not likely to be profitable. As between the use of a straight corn-and-oats mixture fortified in posphorus by one per cent bonemeal and a similar mixture containing 20 per cent of high-protein products, there was less choice but the financial returns slightly favored the low-protein grain under the experimental and price conditions prevailing.

In view of the benefit which evidently is derived at times from the inclusion of some additional source of protein in connection with the farm grains and also the need for additional phosphorus, it seems probable that both these needs can usually be supplied to best advantage by the inclusion in the summer grain mixture of 5 to 10 per cent each of wheat bran and one of the oilmeals.

FORAGE CROPS FOR PIGS

W. L. ROBISON

The provision of an abundance of suitable pasture throughout as much of the year as possible is important in successful swine production. A suitable pasture crop for pigs is relatively high in protein and ash, contains a minimum of crude fiber, is palatable, and is succulent in character. Its ease and cheapness of seeding, its ability to withstand trampling and grazing, its capacity to produce new growth and remain green even during the hot, dry weather of late summer, together with permanence or fitness in a desirable rotation and adaptability to local soil and climatic conditions, are all factors which influence the worth of a forage crop for swine

In 13 experiments comparing similar pigs with and without pasture, the saving in feed per unit of gain and the higher selling price due to faster growth gave the pasture a value of $15.50 an acre even under low-priced conditions such as exist at present

Pasture often has a further advantage of aiding in keeping the pigs in a healthy condition. Since green feeds are good sources of vitamins and are relatively high in ash or minerals, as well as in proteins of good quality, they tend to supply the nutrients which may be lacking in the concentrate portion of the ration, to promote the health of the animal and increase its resistance to

disease. Pasture also provides an environment under which conditions of sanitation are more easily maintained, thus reducing the danger both of infection and of infestation with parasites.

ALFALFA

Alfalfa has no superior as a forage crop for pigs. It should be grown and used for hog pasture much more extensively than it is. Pigs like it exceptionally well. It is relatively high in protein, minerals, and vitamins. It begins growing early in the spring and continues until late in the fall. It produces new growth after being grazed and remains green throughout the summer. It should not be grazed too closely, particularly if the stand is to be left for another year. Nevertheless, few crops will carry as many pigs to the acre as will alfalfa. Alfalfa will not thrive on an acid or a poorly drained soil.

Alfalfa was compared with red clover in 1931 and 1932 and with Dwarf Essex rape in 1929, 1931, and 1933. The pigs on the alfalfa gained 10 per cent faster and required 8 per cent less feed per unit of gain than those on red clover. Not considering the more rapid gains, the alfalfa was worth approximately 12 per cent more an acre than the red clover.

As compared with the pigs on rape pasture, those on alfalfa gained 15 per cent faster and consumed 7 per cent less feed per unit of gain. Taking into account only the saving in feed or concentrates per unit of gain and the gains produced per acre, the alfalfa was worth approximately 22 per cent more an acre than the rape.

RED CLOVER

Red clover equals alfalfa in many respects. They are somewhat similar in composition. Both are especially palatable. Clover probably produces somewhat less forage to the acre and possibly cannot be pastured quite as early in the spring. In seasons of normal rainfall clover will produce new growth throughout the summer if it is sufficiently but not excessively grazed or if it is clipped so as not to permit it to become too advanced in maturity. In dry seasons clover is inclined to dry up and die in late summer; whereas alfalfa remains green. Although on land adapted to its production alfalfa could perhaps be utilized in the same way, clover is more frequently grown in the rotations commonly used in Ohio and other corn belt states.

In seven trials comparing the two crops, pigs on red clover gained 6 per cent faster and consumed 2 per cent less feed per unit of gain, on the average, than similar pigs on Dwarf Essex rape. The clover was worth approximately 9 per cent more an acre than the rape.

In a majority of the forage comparisons the grain fed was restricted somewhat, particularly during the early part of the feeding period, for the purpose of getting the pigs to consume more forage and thus bring out more clearly any differences that might exist in the worth of the crops being compared. In two trials in which pigs carried from 46 to 206 pounds in weight on clover pasture were full fed, they made an average gain of 1.42 pounds daily a head and consumed 326 pounds of corn and 27 pounds of tankage for each 100 pounds of gain produced.

ALSIKE

Alsike is sometimes grown in preference to red clover because of its greater tolerance to an acid condition of the soil. The two crops were compared in three trials. In each the alsike matured and furnished little or no forage after midsummer. Even when only the portion of the feeding periods during which alsike furnished green feed were considered, the red clover not only produced faster gains but also saved sufficient feed per unit of gain, over that consumed by the pigs on alsike, to make it worth $5.72 more an acre than the alsike. Inasmuch as the red clover furnished grazing for a longer period, this figure does not represent the full difference in the worth of the two crops.

As ordinarily used, both alfalfa and red clover must be seeded the year before they are needed for hog pasture. When no such crop is available, an annual crop (one which can be grazed the same season it is seeded) must be made use of.

DWARF ESSEX RAPE

Dwarf Essex rape is one of the most satisfactory annual forage crops for pigs. It requires a well prepared seedbed and a productive soil similar to that best adapted to the production of corn. Rape may be seeded comparatively early in the spring, or, if sufficient moisture is available, as late as the fore part of July. It will provide grazing when 8 to 10 inches high, or from 7 to 8 weeks after the time of seeding until late in the fall. It is not a legume but, nevertheless, is relatively high in protein and in ash or minerals.

By stopping a part of the holes in a grass drill or possibly also in the grass seeding attachment of an ordinary grain drill, rape can be seeded in rows 24 inches apart. This makes it possible to cultivate the rape a time or two, which stimulates growth and aids in keeping down the weeds.

The cost of seeding rape is low. From 3.5 to 4.5 pounds of seed to the acre, if it is drilled in rows, and from 4 to 6 pounds, if it is drilled solid or broadcasted, are sufficient. Rape is not seriously injured by trampling and produces new growth after being grazed. Experimental results at this and other stations have shown that rape is palatable and that if, as sometimes believed, pigs do not relish it at first they soon learn to eat it readily.

The disadvantages of rape are that it is sometimes severely damaged by plant lice, particularly if it is not on a productive soil, and that it sometimes causes the pigs to blister or sun-scald. White or thin-skinned hogs are more likely to sun-scald than are colored or thicker skinned ones. The back and ears are the parts usually affected. Sun-scalding is caused by the pigs getting in the rape when it is wet with dew or rain and then being exposed to the hot sunshine. It is more prevalent in rainy seasons than dry ones and during early summer than later. The blistered areas may be treated with repeated applications of grease or petrolatum. Usually very little trouble from sun-scalding is experienced. If the pigs are watched closely and treated promptly when it does occur, it is not apt to become serious.

MIXTURES CONTAINING OATS, FIELD PEAS, OR SOYBEANS

The findings of tests at the Ohio Station with mixtures of oats and field peas, oats and rape, rape and field peas, and rape and soybeans agree with the findings of similar tests at the Missouri and Pennsylvania Stations in indicating such mixtures to be less valuable as a swine forage than rape alone.

SOYBEAN PASTURE

Soybean pasture was also compared with rape forage. Soybeans cannot be seeded in the spring until the danger of frost is past. Since the leaves of early varieties turn yellow and drop off as the plants mature and late seedings or late maturing varieties are killed by the first frost in the fall, soybeans furnish grazing for only a relatively short period of time. The raw beans themselves are distasteful but the foliage is especially palatable to pigs. In seven trials the rate of growth and the amount of gain per unit of feed consumed were practically the same for pigs on soybean as for similar ones on rape pasture.

The lower carrying capacity due to the failure to produce new growth after being grazed caused the soybean pasture to be worth only about three-fourths as much an acre as the rape. Soybeans are well adapted to supplying an abundance of palatable green feed during midsummer and late summer, or at the time a permanent pasture like blue grass is of little value. They may also be grown under conditions which are less favorable for the growing of rape.

SUDAN GRASS

Sudan grass is an annual introduced from Egypt, which resembles sorghum in composition and appearance, except that it is finer stemmed and produces more stems per plant. It grows luxuriantly, produces a large amount of forage to the acre, and apparently is fairly palatable to pigs, particularly if clipped from time to time to prevent it from heading out and to cause it to produce new growth. Since it will not withstand frost, it has a comparatively short grazing period. In three trials Sudan grass equalled rape in carrying capacity but was not equal to such annual crops as soybeans or rape in feeding value. The Kansas Station reported that Sudan grass was bothered by chinch bugs. In trials at the Kansas and Nebraska Stations it made a somewhat better comparative showing than in the Ohio trials.

SWEET CLOVER

Biennial white sweet clover is another crop which was pastured the same season it was seeded or was tried as an annual forage. The second year's growth is too coarse and woody to be suitable for pigs. March or early seedings were bothered less with weeds than later seedings and also had an opportunity to get more of a start before being needed for pasture. Probably because of its bitter taste, due to the presence of cumarin, the pigs in any of the experiments did not like the sweet clover nor did they learn to eat it readily. In four trials, pigs on rape pasture gained 7 per cent faster and required 5 per cent less feed per unit of gain, on the average, than similar pigs on sweet clover. The sweet clover was worth approximately 18 per cent less an acre than the rape.

SPRING-SEEDED WINTER WHEAT WITH SWEET CLOVER

Beginning in 1931, spring seedings of winter wheat with April or relatively late seedings of sweet clover were made. When sown in the spring, winter wheat does not head out but remains recumbent in its habit of growth. Besides aiding in the control of weeds, it provides excellent pasture during the early part of the grazing period while the sweet clover is becoming established.

Ordinarily the wheat dies out during the latter part of July. The wheat was seeded at the rate of 2 to 2.5 pecks to the acre. Indications were that, when intended for pasture, from 15 to 18 pounds, or rather heavy seedings, of sweet clover were advisable.

The effect of seeding winter wheat with the sweet clover in improving the quality of the forage was shown indirectly by the results as compared with those obtained from rape. Wheat with the sweet clover reduced the quantity of feed consumed per unit of gain from 5 per cent to only 1 per cent more than that consumed on rape pasture and increased the growth from 6.5 per cent less to the same rate as that of the pigs on rape pasture.

PERUVIAN ALFALFA AS AN ANNUAL FORAGE

After finding that sweet clover gave rather poor results, because of its distastefulness to pigs, the conclusion was reached that perhaps seeding alfalfa in the spring and pasturing it the first season, or using it in the same way as sweet clover, would be worth trying. Hairy Peruvian alfalfa, which was reported by the Agronomy Department to be a more rapid growing variety than any of the others tested by them, was selected for the purpose. This variety is commonly grown in Arizona and New Mexico but winter-kills in the North where the temperature falls below 10 degrees above zero. Inasmuch as it was wanted for pasturing the first season, whether it would live through the winter was immaterial.

Pigs on Peruvian alfalfa required less feed or concentrates per unit of gain in two out of three trials and made somewhat faster gains in each than did similar pigs on sweet clover. Their more rapid growth enabled them to be marketed 11 days earlier, but the saving in feed alone made the alfalfa worth 8 per cent more an acre than the sweet clover. Each crop was seeded without winter wheat in one and with winter wheat in two of the experiments.

A summary including three experiments in which Peruvian alfalfa alone and two in which a mixture of Peruvian alfalfa and spring-seeded winter wheat were compared with rape showed no difference in either the average rate of growth or the average amount of feed required per unit of gain produced. The mixture made a more favorable showing in comparison with the rape than did the Peruvian alfalfa alone but probably was not used in a sufficient number of experiments to determine conclusively that the mixture is definitely superior to rape. The mixture was capable of carrying only about nine-tenths as many pigs to the acre as rape. Advantages in its favor are that alfalfa is a legume and that it does not cause sun-scalding.

PERMANENT BLUE-GRASS PASTURE

Blue grass can often be utilized to advantage for the breeding herd or for sows and young pigs, providing it is not contaminated with worm eggs. It forms a sod and can be grazed early in the spring. In its early stages of growth, blue grass is relatively high in protein and minerals. These decrease as the plant matures. During the hot, dry weather of midsummer, blue grass is woody and unpalatable in character and then has a comparatively low value for growing or fattening pigs. Clipping blue grass would probably increase its worth, particularly in seasons when there was sufficient rainfall to produce

new growth. Permanent pastures are subject to the objection that they are likely to become a source of worm infestation if hogs are kept on them for several years in succession.

Crops like rye and wheat may also sometimes be used to advantage in the spring or fall for sows and suckling pigs, but, because of coming at the time of year they do, were not experimented with as forage crops for growing and fattening pigs.

CHICKEN BATTERY COMMENTS

D. C. KENNARD AND V. D. CHAMBERLIN

Batteries of various kinds and their usage continue to be a live topic with many poultrymen. They have been going through their initial fantastic stage with new problems arising that have been attended with many disappointments. At first, it seemed that batteries might suddenly revolutionize present methods of poultry keeping, but as more experience and information become available it is obvious that batteries must pass through a tedious process of development before their true merits for practical poultry keeping can be established. Batteries may now be regarded as in their second phase—that of a long-time sober development from new information and experience constantly becoming available.

A résumé of this Station's battery work was published in the May-June, 1933, Bimonthly Bulletin. The battery tests have been continued; and, although the subsequent work is in agreement with the results previously published, the present purpose is to report some additional results, developments, and experiences.

INDIVIDUAL LAYING BATTERIES

The tests thus far conducted at this Station have indicated no substantial difference in egg production, mortality aside from respiratory disorders, or feed consumption of the layers confined in batteries when compared with similar birds in laying houses. While individual cages may find an important place in modern poultry keeping, it seems they can hardly be relied upon, as yet, to reduce materially the mortality of layers, except that due to pickouts and possibly respiratory complications if the battery housing conditions are correct. At least during the first 2 years' tests at this Station with larger numbers of layers in individual cages, practically no trouble was experienced with respiratory disorders among the caged layers; whereas similar birds in the laying house had their usual troubles in this respect. During the third year (1933-1934) a few cases of colds were observed among the caged layers; whereas a serious epidemic of colds, roup, and pox, attended with a considerable loss of birds, was experienced among the housed layers.

TABLE 1.—Egg Production and Mortality of Pullets in Batteries Versus Laying House

August 30, 1933, to January 31, 1934

	Test No.	No. of pullets	Eggs per bird	Causes of mortality*			
				Paralysis	Colds, roup, pox	Undetermined	Total
				Pct.	*Pct.*	*Pct.*	*Pct.*
Individual batteries	1	120	42	5.8	2.0	14.0	22.0
Laying houses	1	200	37	6.0	11.0	17.0	34.0
Individual batteries	2†	204	54	8.0	1.5	9.5	19.0
Laying houses	2†	300	44	6.0	11.0	16.0	33.0

*As observed from behavior and external observations.
†Pullets brooded on floor and grown in batteries.

The egg production was low and the mortality high in both the caged and floor birds. The difference of egg production and mortality in favor of the battery layers was principally due to the greater severity of colds, roup, and pox among the pullets in the laying houses. The housing conditions of the caged layers were more favorable in that the volume of air per bird was greater and a more uniform temperature was maintained than was possible in the laying houses. However, the fact that the individually caged layers were less exposed to each other and never came in contact with the floor litter may also have been a protecting factor against the respiratory disorders. The usual low-ceiling type of laying house is ill suited for housing batteries and makes it difficult to compare directly the housing conditions of caged layers with those of a laying house. The laying house in the case of Test Number 2 was well insulated and heated by means of hot water so as to maintain with but few exceptions a temperature of 40 to 60 degrees during the winter months. Conditions were about as favorable in this house as could generally be provided in a laying house. Nevertheless, there may have been uncertainties and unfavorable conditions of an obscure nature less likely to be found in the battery room with an 8-foot ceiling located in a large steam-heated building where the temperature and ventilation were under better control. The fact that the battery room is large and that only one-third of its potential bird capacity was occupied was in itself assurance of adequate ventilation. Hence, in the consideration of the above results it should be remembered that battery birds had the benefit of more favorable housing conditions, which may largely explain their being less subject to respiratory disorders.

Whether the layers were caged or housed they were about equally subject to those baffling complications such as paralysis, leukemia, typhoid, and cholera-like diseases of which the causes, transmission, prevention, control or remedy are not definitely known. A symptom of these diseases generally observed before the ailment or death of individually caged layers was the characteristic small quantity of green-white-yellowish, small calibered or liquid droppings. Had one the same opportunity for observing the floor birds, undoubtedly the same condition would be found. One of the greatest needs of the poultry industry today is for more definite information as to cause, prevention, and control of these types of diseases.

THE MITE PROBLEM

Infestation of all-metal, individual laying batteries with red mites was a new and very serious problem encountered during the year of 1933. It resulted in loss of eggs, loss of birds, and discontinuation of some of the tests. Should a practical poultryman with a considerable number of layers in individual cages have a similar experience it would be a serious problem to cope with unless a more effective and practical means of prevention and eradication of these pests was available. While spraying the equipment with anthracine or creosote oils proved effective for prevention and eradication of mites, its use has a number of objections. There is great need for a more satisfactory procedure. The oils discolor the birds' plumage and may soil a considerable number of eggs. When the batteries were thoroughly soaked with the oil it appeared to affect the behavior of the birds and their egg production adversely even if the birds were not put into the cages until some weeks after spraying the cages. The fact that this procedure necessitates removal of the birds from the battery constitutes a serious problem in itself. However, in practice this difficulty may be avoided by thoroughly spraying the empty equipment between removal of one set of birds and the introduction of the birds to follow. If this is done once a year it would seem that the oil should prevent reinfestation. Our difficulty was that we started with new and unprotected equipment. This experience suggests the advisability of spraying new equipment before using.

WATERING DEVICES

The automatic watering devices with large cups were found unsatisfactory because they were too unsanitary or required too much time for cleaning. In an effort to correct this difficulty we designed a wire-loop drip waterer, Figure 1, which has proven a considerable improvement over the other devices in question. It consists of a solid No. 2 to 6 gauge galvanized or copper wire with loops where it is desired to permit the birds to drink. The water flows down on the outside of the wire until it reaches the loops where it becomes a drip making the water available for the birds. Each loop serves two birds and each wire may have different loops to serve as many decks of batteries as desired. Some manufacturers of individual laying batteries have adopted the wire-loop drip device for their equipment.

Another type of waterer was designed, as shown in Figure 2. It consists of a small copper cup attached to a solid No. 2 gauge galvanized or copper wire. The cup is designed so as to be self-cleaning. The water flows from one cup to the other on the outside of the wire as in the case of the wire-loop waterer, so that it is proof against clogging. The small cup waterer may be located 1 inch below the top of the feed container to insure against the birds wetting their feed. Both the wire-loop and the small self-cleaning cup waterers have proven to be satisfactory solutions of the watering problem.

Where a continuous flow of water is maintained and it is desirable to use the large cup equipment, we found they were much improved by lowering or cutting down the inner overflow tube so that the depth of water in the cup was reduced to ¼ inch. In case of some types of cups the top part may need to be removed in order to make the small amount of water in the bottom readily available. With this small volume of water the accumulation of sludge from waste feed was largely eliminated, and, furthermore, it was a great aid in the prevention of the birds wetting their feed.

Fig. 1.—Upper—Waterer with wire-loop drip for individual laying batteries. Lower—Waterer for individual laying batteries, having small self-cleaning cup attached to wire.

UNSOLVED PROBLEMS

The belt cleaning device has presented an unsolved problem since we have yet to find the belting material which meets all the requirements. However, a solution of this problem can be expected in the near future.

Our past year's experience has convinced us that shells or limestone grit should be fed in a separate container and that, if it is desired to feed whole grain and mash, the feeding device should be divided into separate compartments for whole grain, mash, and shells.

The wetting of the feed in case of some watering devices may become a serious matter. Once the birds acquire the habit it is difficult to overcome, especially if the water is close to the feed. However, this problem can be solved for the most part by following the suggestions previously offered in connection with watering devices.

Soiled eggs from individual batteries have been a problem. When the fresh-laid, moist egg comes in contact with the wire floor, the egg may become slightly streaked. Although the egg may be but slightly soiled, yet it passes as a soiled egg. The egg may also become soiled when it rolls into the wire-basket egg container. The container collects dust and becomes capable of soiling eggs when they roll into the basket when they are moist.

TRIPLE-PURPOSE PEN BATTERIES

A later development of batteries for chickens is the triple-purpose pen battery recently designed by this Station. This battery, which consists of one set of equipment for all purposes, has been described in Poultry Division Circular No. 8, which can be secured by those interested. It is a three-deck, six-compartment battery, 3 x 18 feet, which has been used successfully for battery brooding, growing cockerels and pullets, and for layers. One unit serves for 300 chicks, 100 to 150 growing cockerels or pullets, and 90 layers. This type of battery is advantageous for farm poultry keepers because it can be made at home and can be used for the different phases of poultry keeping.

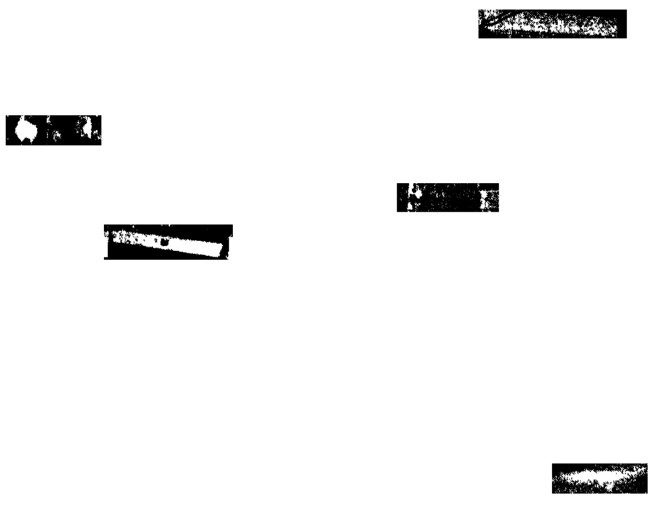

Fig. 2.—Triple-purpose battery for brooding chicks, growing broilers, and pullets and for layers

BATTERY BROODING

The triple-purpose battery was adapted for brooding by installation of portable hovers in the ends of the 3 x 8-foot compartments. The hovers are 3 x 2 feet and 9 inches high. They are heated by two electric bulbs or by an electric heating assembly with thermostatic temperature control. Insulating board lined with Masonite pressed wood was used for making the top, back, and sides of the hover. Two curtains were placed in front. One curtain was attached to the front edge of the hover and another curtain was placed 4 inches back of the front one. The curtains were made of heavy denim (20 oz.) with a 3-inch slit every 5 inches to permit the chicks to go in and out. The slits and unselvaged edges of curtains were bound with heavy bias tape to prevent ravelings which are objectionable and may cause death of chicks. The space between the bottom edge of the curtains and the floor was ½ inch. Wire-netting frames were suspended above the tops of the front edges of the hovers to prevent the chicks from getting on top of the hovers. The permanent 2 x 1-inch floor was covered with ½-inch mesh hardware cloth 3 feet wide and about 9 feet long while used for brooding. The fronts were either covered with or replaced by 1-inch, or smaller, mesh netting or hardware cloth to retain the chicks while small. The feeding and drinking equipment was kept inside during the first 5 or 6 weeks. The special brooding equipment may generally be removed after 6 weeks or when the chicks no longer need the hovers.

The whole subject of batteries for chickens is and promises to continue to be in its experimental stage of development insofar as the large majority of poultry keepers are concerned. While great progress is being made with batteries, their present use is beset with limitations and uncertainties. Nevertheless, they offer promising possibilities for the future.

CABBAGE CLUBROOT IN MUCK SOILS

J. D. WILSON

INTRODUCTION

Clubroot of cabbage is very common in Ohio gardens and occurs in certain of the muck areas of the State where cabbage has been grown frequently. The disease, which is caused by a slime mold (*Plasmodiophora brassicae* Wor.), has as its distinguishing symptom the development of large overgrowths, or hypertrophies, on affected roots. The causal organism persists in the soil for an indeterminate number of years after it has once been introduced, even in the absence of cultivated hosts of the family Cruciferae. Little resistance to clubroot infection, with the possible exception of certain strains of turnips, has ever been observed among the economic species of the crucifers. The fact that a few species of this family which occur as weeds in Ohio are susceptible to clubroot suggests that these may serve as a vehicle of survival for the causal organism from year to year. Reports are common of the recurrence of clubroot from 3 to 7 years after a crop of cabbage was grown in a field; one instance has been brought to the attention of the writer in which this interval was 10 years in length in a muck area. This would seem to rule out crop rotation as a means of checking the disease in muck soils.

The cabbage plant is susceptible to infection at any time from its seedling stage until it has produced a crop of seed in its second year. Since infection frequently occurs in the seedbed, no seedlings should be used from a bed showing any clubbed roots because many apparently healthy ones may already be infected, even if infection is not evident.

Clubroot, by destroying the fibrous nature of the normal root system, decreases the capacity to absorb water, and, as a result, the plant wilts on hot, dry days and during periods of low soil moisture. This recurrent wilting finally stunts the plant so severely that no head is produced. The disease is considered to be most severe in soils containing water in excess of one-half their water-holding capacity. For this reason good soil drainage has been recommended as one of the first steps to be taken in an effort to keep it in check. However, Wellman (1) suggests that infection may take place during the period of high soil-moisture conditions following any heavy rain. It is also possible that the practice of watering-in plants may provide sufficiently good conditions for infection to occur. After infection occurs, the disease may develop even in a comparatively dry soil and then the affected plant is under an extra handicap in water absorption. Thus, the yield may be as greatly decreased by the disease in a dry soil as in a wetter one.

RESULTS OBTAINED WITH VARIOUS MATERIALS BY OTHER INVESTIGATORS

Many investigators have tested a wide variety of compounds in an effort to check clubroot; however, conflicting or indifferent results still make it difficult to give definite recommendations for the control of the disease under all conditions of climate and soil. The fact that the causal organism does not commonly attack a susceptible host plant growing in a soil of alkaline reaction as actively as in an acid one affords a possible means of controlling the disease; thus, the addition of some material to the soil to give it the necessary (inhibiting) degree of alkalinity has been tried. Such compounds as marl, wood ashes, oyster shells, gypsum, raw limestone, and various forms of lime have been used for this purpose. Chupp (2), in a series of soil treatments in which he added various quantities of lime and sulfur to the soil, found the disease to develop most vigorously with a soil having a reaction of pH 6.0 to 6.5, with 100 per cent infection sometimes occurring at 6.0. With a pH value of 7.1, only 8.5 per cent of the plants was diseased; and at 7.8, control was complete. Several investigators have reported control with pH values from 7.3 to 8.0. Wellman (1) discovered the disease in fields having a wide range of acid and alkaline reactions. He found that increasing the pH value of the soil to 8.0 by the addition of potassium carbonate did not control the disease but that control was obtained at a pH of 7.3 if hydrated lime were used. Accordingly, he regards hydrated lime as the most effective compound of calcium for use in controlling clubroot.

Besides the calcium-containing compounds, which are used primarily to alter the soil reaction, a wide variety of others has been tested. A few of those which have been reported to be fairly effective in controlling clubroot are: Uspulun (used at the rate of 1 pound to 25 square feet or 1 gallon of a 1-400 dilution to 40 feet of row) and other proprietary organic mercury com-

1. Wellman, F. L. 1930. Clubroot of crucifers. U. S. Dept. Agr. Tech. Bull. 181, 1-31.
2. Chupp, C. 1920. Clubroot in relation to soil alkalinity. Phytopath. 18: 301-306.

pounds, mercuric chloride (Clayton, 3) (1-1500 dilution at 1 gallon to 40 feet of row), and bordeaux mixture (3200 pounds of calcium oxide per acre). Calcium cyanamide (100 to 300 pounds per acre, used alone or with basic slag and potash) and calomel have been credited with a fair degree of control in some instances. Phenol-containing compounds, formalin, nicotine sulfate, copper sulfate, sulfur, superphosphate, and lime-sulfur have been used with indifferent results. When lime-sulfur was added to the soil, it was found to be injurious to the cabbage.

Many of the experiments reported above on the control of cabbage clubroot have been performed on highly mineral soils. When muck soils are considered, the treatments must usually be greatly increased because of the high buffer capacity of these soils. Barnes (4) showed that addition of one ton of limestone per acre to seven Ohio soils (ranging from a fine sand to a clay loam) changed their pH value from 0.20 to 0.50 in the range between pH 4.5 and 7.0. In additional (unpublished) data this quantity of limestone has been found to alter the pH value of certain samples of muck soil only 0.05 to 0.10 pH. Thus, instead of the one to 4 tons of limestone recommended for mineral soils, from 4 to 30 tons per acre would be required to alter the reaction of some muck soils sufficiently to give them a pH value of 7.2 to 7.4, the point at which clubroot develops but little. Contrasted with the larger of these quantities, 6 tons per acre have been found by the author to cause stunting of cabbage and onions in at least two different muck soils.

Hydrated lime is generally known to be particularly effective in altering quickly the pH value of soils to which it is added. When this material is added to a soil, the change in reaction quickly reaches a maximum value; however, this value is not maintained as time goes on and at the end of a time period of indeterminate length (a few months) the pH value should be approximately equal to what it would have been had an equivalent amount of limestone been used. Chupp (2) noted this effect of hydrated lime in studies on clubroot control. It is possible that this temporarily high concentration of OH ions which is attained quickly following the application of hydrated lime to a soil is one of the factors involved in making this material peculiarly effective in checking clubroot.

RESULTS OF GREENHOUSE TESTS

The fact that the addition of hydrated lime in the usual quantities to muck soils was not controlling clubroot of cabbage was brought to the attention of the writer in several instances during the summers of 1926 and 1927. Preliminary experiments on the treatment of some of these soils with various compounds in an effort to control the disease were carried out in benches in a greenhouse in the winter of 1927-1928. Quantities of soil from a field known to be badly infested with the causal organism of clubroot were used. The average initial reaction of this soil was pH 6.24. Five lots of this soil were treated with hydrated lime used at the rates of 1, 2, 3, 4, and 5 tons per acre, respectively, and a sixth lot was left untreated. The volume of soil used in computing the quantity of lime to be added was on the basis of 6 acre-inches. One week later cabbage seed was sown in each lot of soil. Eight weeks later

3. Clayton, E. E. 1926. Control of seedbed diseases of cruciferous crops on Long Island by the mercuric chloride treatment for cabbage maggot. N. Y. (Geneva) Agr. Exp. Sta. Bull. 537.

4. Barnes, E. E. 1932. Effect of liming at different rates on the pH value of seven Ohio soils. Ohio Agr. Exp. Sta. An. Rept. 50, 50-51.

the plants were removed and the percentage having clubroot was calculated for each treatment. Soil reaction values were determined by the use of a quinhydrone electrode at this time. This procedure was repeated twice on other lots of the same soil. The average values for the percentage of clubroot and the pH values of the soil were as follows: the percentage of clubroot in lots of soil receiving no treatment and 1, 2, 3, 4, and 5 tons of hydrated lime per acre were 71, 61, 48, 28, 13, and 4, respectively, and the corresponding pH values were 6.24, 6.46, 6.65, 6.92, 7.03, and 7.22. These trials indicated that the use of 4 or 5 tons of hydrated lime per acre would considerably reduce the number of plants diseased at the age of 8 weeks. Had the plants been allowed to remain in the soil for a longer period, more of them would undoubtedly have become infected.

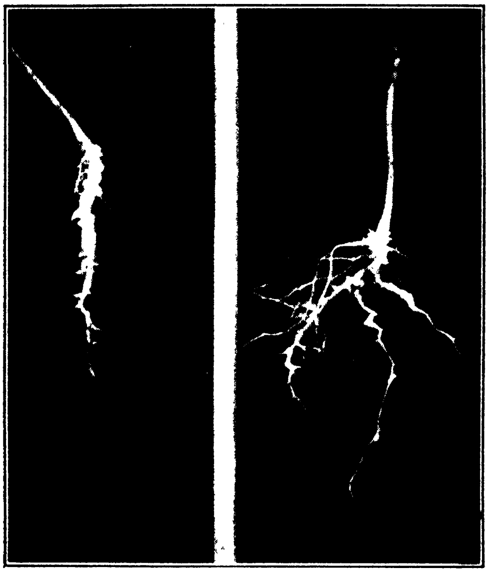

Fig. 1.—Growth habit of cabbage roots growing in muck soil and affected with clubroot. Left, from untreated soil (pH 6.23) and, right, from soil treated with aluminum sulfate at the rate of 2000 pounds per acre (pH 5.90).

These trials were followed by others in the greenhouse in which a wide variety of treatments was used. The results of some of these tests are shown in Tables 1 and 2. In one experiment various lots of an infested muck soil were treated with different quantities of hydrated lime and aluminum sulfate. The latter material was used to determine the effect on the disease, if any, of making the soil more acid than it was in the field. The first planting of cabbage seed was made about one week after the treatments were applied to the soil. The plants were removed and examined 8 weeks later. The pH values of the variously treated lots of soil were determined at this time. The same procedure was followed for two more plantings in the same soil lots. The results are shown in Table 1. These data again showed that 5 tons of hydrated lime per acre materially reduce the amount of disease which may occur on plants 8 weeks old, under the conditions present in a greenhouse bench. Making the soil more acid with aluminum sulfate did not significantly increase the percentage of diseased plants.

One striking characteristic of the growth of diseased roots in the soils treated with 2000 pounds or more of aluminum sulfate per acre was noted in these experiments. Whereas the diseased roots in untreated soils usually developed one or two compact enlargements, those growing in the soil treated with aluminum sulfate exhibited a more spreading habit of growth with many small and more or less isolated hypertrophies. This difference in growth habit may have been due to a retarding effect of the aluminum sulfate on the

development of the enlargement after infection occurred, or infection itself may have been retarded in the treated soil for some time after it had occurred in the untreated soil—that is, until the root system of the cabbage seedling had become more spreading. Naumova (5) made a similar observation concerning the development of clubroot hypertrophies on cabbage roots in variously treated soils. The two types are shown in Figure 1 with a root grown in untreated soil on the left and one from the soil treated with aluminum sulfate on the right.

TABLE 1.—Relative Influence of Hydrated Lime and Aluminum Sulfate on the Amount of Cabbage Clubroot Occurring in Muck Soils in Greenhouse Benches

Treatment and application	Percentage of plants having clubroot Seed planted—				Average of 3 soil reaction determinations
	Jan. 7	Mar. 2	Apr. 30	Average	
Lb. per A.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*pH value*
No treatment	98.6	86.0	76.7	87.1	6.23
2,000 lb. lime	95.9	89.0	50.0	78.3	6.49
4,000 lb. lime	87.2	77.1	38.6	67.6	6.61
6,000 lb. lime	80.4	36.5	10.3	42.4	7.05
8,000 lb. lime	28.7	7.7	8.9	15.1	7.17
10,000 lb. lime	11.8	1.0	5.0	5.9	7.30
500 lb. aluminum sulfate	97.7	77.7	85.7	87.0	6.11
1,000 lb. aluminum sulfate	98.0	83.5	80.0	87.2	6.14
1,500 lb. aluminum sulfate	99.0	80.9	82.0	87.3	6.05
2,000 lb. aluminum sulfate	100.0	81.0	74.7	85.2	5.90
2,500 lb. aluminum sulfate	100.0	94.8	79.9	91.6	5.82

TABLE 2.—Influence of Various Compounds on Amount of Clubroot Occurring in Muck Soils When Cabbage was Grown in Greenhouse Benches

All results are the averages of two trials

Treatment and application	Chinese cabbage		Cabbage	
	Plants affected with clubroot	Soil reaction	Plants affected with clubroot	Soil reaction
Lb. per A.	*Pct.*	*pH value*	*Pct.*	*pH value*
No treatment	88.4	6.24	72.0	6.27
6,000 lb. hydrated lime	15.3	6.90	9.9	7.02
12,000 lb. hydrated lime	2.2	7.28	....	....
6,000 lb. lime + 3,000 lb. superphosphate	6.3	6.88	....	....
1,200 lb. superphosphate + 100 lb. potassium chloride	....	....	40.0	6.33
3,000 lb. lime + 500 lb. superphosphate + 100 lb. potassium chloride	....	....	17.1	6.75
400 lb. chlorinated lime	....	....	35.0	6.62
$HgCl_2$ (1–500), 1 gal. to 40 ft. of row	....	....	32.4	6.30
67 lb. $HgCl_2$ as 1–10 with Kaolin	37.1	6.21	....	....
33 lb. $HgCl_2$ + 33 lb. Cresylic acid	52.5	6.23	....	....
67 lb. $HgCl_2$ + 33 lb. $CuSO_4$	23.8	6.30	....	....
50 lb. $CuSO_4$ + 50 lb. phenol	65.0	6.26	....	....
20 lb. mustard oil as 1–20 with Kaolin	....	....	52.0	6.33
30 lb. potassium permanganate + 570 lb. sulfur	....	....	65.1	5.74
30 lb. potassium permanganate + 570 lb. sulfur + 1,000 lb. lime	....	....	61.2	5.96

5. Naumova, N. A. 1933. A contribution to the knowledge of the influence of soil factors on the development of Plasmodiophora in Cruciferae. Bull. Plant Protection, Series III, Phytopath. 3: 32-49.

In Table 2 the relative effectiveness of a number of soil treatments in controlling clubroot, in two trials selected from a number of similar ones, is shown. None of the treatments, aside from those containing hydrated lime alone or with other materials, gave any worthwhile control of the disease. The variations in pH values of the differently treated lots of soil, excluding again those treatments containing lime, are more apparent than real, some of them probably being simply the variations normally found in testing different samples of soil. The degree of control obtained with the various treatments corresponds in general to that obtained by other investigators. With the exception of lime, most of the other compounds listed in Table 2 would be too costly for general use in the field.

RESULTS OF FIELD EXPERIMENTS

Following these preliminary trials, field experiments using a variety of soil treatments were conducted during three different summers. The data relative to two of these trials are given in Table 3. Restricted areas were selected in fields of muck soil known to be highly infested with the clubroot organism. The various treatments used in a particular experiment were applied in duplicate to plots 1/100 acre in extent. After the land had been plowed and harrowed the materials were added to the soil surface and thoroughly worked into the soil. This was done about 4 weeks before the plants were transplanted early in June. As may be seen in Table 3, the percentage of plants which had the disease at harvest time was very large in all but the heaviest lime treatments. As determined at the time of harvest, the change in pH value of the soil brought about by the addition of hydrated lime was nearly as great as that occurring in the greenhouse trials but the control of clubroot was not as good. This was consistently true in the field trials. The 5-ton lime treatment at Lodi resulted in a slight stunting of the cabbage plants, indicating this to be about the maximum treatment possible for hydrated lime added such a short time before transplanting. The results of these field trials, representative examples of which are shown in Table 3, indicate that the hope of controlling the disease in muck soils, with an original pH value in the neighborhood of 6.0, is rather remote.

TABLE 3.—Effect of Various Soil Treatments on the Amount of Cabbage Clubroot Occurring in Fields of Muck Soil in Ohio

Treatment and application	Lodi		Shreve	
	Plants affected with clubroot	Soil reaction	Plants affected with clubroot	Soil reaction
Lb. per A.	*Pct.*	*pH value*	*Pct.*	*pH value*
No treatment	80	6.13	88	6.03
2,000 lb. hydrated lime	68	6.18	89	6.36
4,000 lb. hydrated lime	56	6.46	81	6.47
6,000 lb. hydrated lime	32	6.68	70	6.93
8,000 lb. hydrated lime	24	6.95	67	6.96
10,000 lb. hydrated lime	11	7.28	28	7.16
1,000 lb. hydrated lime + 1,000 lb. superphosphate	74	6.10	76	6.30
2,000 lb. hydrated lime + 2,000 lb. superphosphate	63	6.20	80	6.36
2,000 lb. superphosphate	77	5.93	84	6.05
400 lb. sulfur (300 mesh)	82	5.82	87	6.07
800 lb. sulfur	82	5.40	83	5.78
40 lb. $HgCl_2$	64	6.10	86	6.15
40 lb. $HgCl_2$ + 1,000 lb. lime	74	6.15	72	6.19
40 lb. $HgCl_2$ + 100 lb. $CuSO_4$	65	5.98	69	5.95

RESULTS OF TESTS WITH DIFFERENT LAYERS OF SOIL

One would expect the degree of clubroot control to be somewhat better in the greenhouse with the lime thoroughly mixed with the soil than in the field where the amount added had to suffice for a layer of soil at least 12 inches deep and could not be mixed with even the surface soil as thoroughly as with that used in the bench. It was decided to ascertain, if possible, the amount of infection which would occur when cabbages were planted in untreated soil from layers at different depths. In two experiments the first 4 (0-4) inches of soil were removed in early March from a small area in a highly contaminated field and placed in a greenhouse bench. The procedure was then repeated for the second 4 (5-8) inches, and the third 4 (9-12) inches. Cabbage seed was then planted in each lot of soil. At the end of 8 weeks the percentages of diseased plants in the 0-4, 5-8, and 9-12 inch soil layers were 73, 56, and 43, respectively. Results obtained when the experiment was repeated in late May were very similar. These data indicate that the causal organism is well distributed throughout at least the first 12 inches of soil and suggest that one would have to distribute lime to approximately this depth to obtain good control of the disease.

In an effort to determine the influence on clubroot control of treating different layers of muck soil containing the causal organism, four benches were filled to a depth of 6 inches. None of the soil in one bench was treated, all of it was treated with hydrated lime at the rate of 5 tons per acre in another, in the third bench an equal amount of lime was mixed only with the surface 3 inches of soil, and in the fourth the lime was placed only in the second (bottom) 3 inches. Cabbage seed was then planted in all four soils, and at the end of 8 weeks the seedlings were removed and examined for the presence of clubroot. The percentages of diseased plants in untreated, all treated, upper half treated, and lower half treated soils were 45, 0, 13, and 34 per cent, respectively. These results indicate the importance of mixing the lime throughout the soil mass and illustrate what may happen in the way of infection when only the surface layer is treated.

Preliminary tests conducted in the greenhouse during the course of this work indicated that hydrated limes high in magnesium are more effective in changing the soil reaction than those high in calcium but are slightly less efficient in reducing clubroot infection. Calcium oxide and magnesium oxide were considerably less effective in disease control than hydrated lime.

SUMMARY

Cabbage clubroot occurs in many Ohio gardens and in certain muck areas in which cabbage has been grown frequently. The cabbage is susceptible to infection from the seedling stage to the time it matures seed the second year. The disease is not usually severe in soils having an alkaline reaction corresponding to a pH value of 7.3 to 7.4. The addition of highly alkaline materials in sufficient quantity (from 1 to 4 tons of lime on most Ohio soils, depending upon the type and initial acidity) to give the soil this pH value usually gives fair control of the disease on upland (mineral) soils. Hydrated lime is the most effective of these alkaline materials in controlling the disease. Many other materials with definite fungicidal properties have been used by various investigators in an effort to control clubroot, but only those containing mercury in some form have given any worthwhile results and these are too costly for use anywhere except in the seedbed.

Although the addition of hydrated lime at rates corresponding to 5 or 6 tons per acre gave a fair degree of clubroot control in muck soils placed in greenhouse benches, even these quantities did not give satisfactory control of the disease in these soils in field trials. A variety of other fungicidal compounds failed to reduce the disease to any appreciable extent under field conditions. The disease was found to be nearly as severe in cabbage grown in soil representing the layer from 9 to 12 inches beneath the surface as in that from nearer the surface. The results obtained in the field trials here reported indicate that one may expect to find it difficult to obtain satisfactory control of cabbage clubroot in muck areas through the use of compounds now available, not excepting hydrated lime.

POLLINATION OF THE APPLE IN OHIO

FREEMAN S. HOWLETT

The completion of 10 consecutive years of apple pollination (1923-1932) in Ohio justifies a report of the results in a practical form for the orchardist. The material given herein does not supersede the publications already made. For complete information attention is called to the bulletins listed at the end of this article.

At one time or another during the course of this work all the methods known to be of value in determining the self-fruitfulness of an apple variety have been employed. A large number of cross-pollination tests have also been made. As a result of this work, certain general rules may now be formulated in regard to the pollination of apples.

SELF-FRUITFULNESS OF APPLE VARIETIES

All the varieties used in the Ohio experiments have failed to give sufficient fruits when self-pollinated to warrant being planted in locations where they would be largely, if not entirely, self-pollinated. Not a single apple variety has given a "full crop" of fruit when self-pollinated. A "full crop" has been arbitrarily considered to be an average of one fruit per fruiting point with these fruiting points consecutively spaced from each other a certain specified distance—namely, that used in thinning.

Pollination studies were conducted on the varieties listed below:

Arkansas (Mammoth Black Twig)
Baldwin
Delicious, Richared, Starking
Ensee
Gallia Beauty
Golden Delicious
Grimes Golden
Jonathan
McIntosh
Northern Spy, Red Spy
Ohio Nonpareil
Oldenburg
Ralls
Rhode Island Greening
Rome Beauty, Red Rome
Stark
Stayman Winesap, Blaxtayman, Stamared
Summer Rambo
Tompkins King
Turley
Wealthy
Winesap
Winter Banana
Yellow Transparent

Workers in other states have shown that the following apple varieties are not sufficiently self-fruitful for full crops:

Ben Davis	Macoun
Cortland	Melba
Early McIntosh	Milton
Gano	Northwestern Greening
Gravenstein, Banks, Red Gravenstein	Wagener
Joyce	York Imperial

Of the above varieties four have produced an appreciable number of fruits when self-pollinated, even though insufficient for a full crop. These varieties have never given more than a half crop under the most favorable self-pollination tests:

Baldwin	Jonathan (one-third crop)
Gallia Beauty	Rome Beauty, Red Rome

The importance of this information lies in the fact that trees of these varieties may be located somewhat further from their pollinizing varieties than those varieties which give few or no fruits when selfed, without noticeably unfavorable effects on fruiting.

The varieties giving very few or no fruits when self-pollinated are:

Arkansas (Mammoth Black Twig)	Ohio Nonpareil
Delicious, Richared, Starking	Paragon
Gravenstein, Banks, Red Gravenstein	Rhode Island Greening
Nero	Stayman, Stamared, Blaxtayman
	Tompkins King
	Turley
	Winesap

As pointed out in Bulletin 483, "Factors Affecting Fruit Setting. I. Stayman Winesap", no tree of Stayman, Stamared, or Blaxtayman should be at a distance greater than two rows (90 feet) from its pollinizing variety. This precaution should also be taken with the other varieties in this light-setting group. Furthermore, trees of these varieties should be kept under the proper growth conditions, and all provisions should be made for effective cross-pollination.

EFFECTIVENESS OF VARIETIES AS POLLINIZERS

VARIETIES OF NO VALUE AS POLLINIZERS

Certain apple varieties are of no value as pollinizers because of non-viable pollen. This list is continually being enlarged. Those of importance to Ohio fruit growers at present are:

Arkansas (Mammoth Black Twig)	Paragon
Baldwin	Rhode Island Greening
Gravenstein, Banks, Red Gravenstein	Stark
Minkler	Stayman, Stamared, Blaxtayman
Nero	Tompkins King
Ohio Nonpareil	Turley
	Winesap

VARIETIES OF VALUE AS POLLINIZERS

The following varieties have viable pollen and have been shown to be effective in producing fruits on the varieties to which they are not too closely related:

Ben Davis
Cortland
Delicious, Richared, Starking
Early McIntosh
Gallia Beauty
Gano
Golden Delicious
Grimes Golden
Jonathan
Joyce
Lobo
McIntosh
Macoun
Maiden Blush
Melba
Milton
Northern Spy, Red Spy
Northwestern Greening
Oldenburg
Ranier
Rome Beauty, Red Rome
Sutton
Wagener
Wealthy
Winter Banana
Yellow Newtown
Yellow Transparent
York Imperial

COMBINATIONS OF RELATED NEW VARIETIES WHICH ARE FULLY FRUITFUL

(The female (seed) parent is given first)

McIntosh × Cortland
Cortland × McIntosh
McIntosh × Melba
Melba × McIntosh

The experiments with these varieties have been carried out in New York and in Canada.

COMBINATIONS OF VARIETIES UNFRUITFUL BECAUSE OF CLOSE RELATIONSHIP

(The female (seed) parent is given first)

Delicious × { Starking, Richared }
Richared × { Delicious, Starking }
Northern Spy × Red Spy
Red Spy × Northern Spy
{ Rome Beauty, Red Rome } × Gallia Beauty
Gallia Beauty × { Rome Beauty, Red Rome }

COMBINATION OF VARIETIES UNFRUITFUL FOR REASONS YET UNKNOWN

(The female (seed) parent is given first)

Arkansas (Mammoth Black Twig) × Grimes Golden

COMBINATIONS UNFRUITFUL BECAUSE OF DISPARITY IN TIME OF BLOOMING

Table 1 gives several combinations of two varieties which would be unfruitful because their blooming period does not overlap. An example of such a combination is Oldenburg intended to be pollinated by Rome Beauty, or vice versa. Ohio Nonpareil also blooms too early to be effectively pollinated by Gallia Beauty, Rome Beauty, Northern Spy, or Winter Banana.

TABLE 1.—Fruitfulness of Various Combinations of Ohio Apple Varieties. Determined at the Ohio Agricultural Experiment Station, 1923-1932, Inclusive

Seed parent	Pollen parent															
	Baldwin	Cortland	Delicious, Starking, Richared	Gallia Beauty	Golden Delicious	Grimes Golden	Jonathan	McIntosh	Northern Spy, Red Spy	Oldenburg	Rhode Island Greening	Rome Beauty, Red Rome	Stayman, Stamared, Blaxtayman	Wealthy	Winter Banana	Yellow Transparent
Baldwin	—p—	CCC	CCC	CCC	CCC	CCC	CCC	CCC	CCC	CCC	....	CCC	....	CCC	CCC	CCC
Cortland	....	....	CCC	X	CCC	CCC	CCC	CCC	X	CCC	....	X	....	CCC	CCC	CCC
Delicious, Starking, Richared	....	CCC	....	CCC	CCC	CCC	CCC	CCC	CCC	CCC	....	X	....	CCC	CCC	CCC
Gallia Beauty	....	X	CCC	—p—	CCC	X	CCC	X	CCC	B. S.	....	—p—	....	X	CCC	X
Golden Delicious	....	CCC	CCC	CCC	....	CCC	CCC	CCC	CCC	X	....	CCC	....	CCC	CCC	CCC
Grimes Golden	....	CCC	CCC	X	CCC	....	CCC	CCC	X	CCC	....	X	....	CCC	CCC	CCC
Jonathan	....	CCC	CCC	CCC	CCC	CCC	—p—	CCC	CCC	CCC	....	CCC	....	CCC	CCC	CCC
McIntosh	....	CCC	CCC	X	CCC	CCC	CCC	....	X	CCC	....	X	....	CCC	CCC	CCC
Northern Spy, Red Spy	....	X	CCC	CCC	CCC	X	CCC	X	....	B. S.	....	CCC	....	X	CCC	X
Oldenburg	....	CCC	CCC	B. S.	X	CCC	CCC	CCC	B. S.	....	....	B. S.	....	CCC	X	CCC
Rhode Island Greening	....	CCC	CCC	CCC	CCC	CCC	CCC	CCC	CCC	CCC	....	X	....	CCC	CCC	CCC
Rome Beauty, Red Rome	....	X	CCC	—p—	CCC	X	CCC	X	CCC	B. S.	....	—p—	....	X	CCC	X
Stayman, Stamared, Blaxtayman	....	CCC	CCC	X	CCC	CCC	CCC	CCC	X	CCC	....	X	....	CCC	CCC	CCC
Wealthy	....	CCC	CCC	X	CCC	CCC	CCC	CCC	CCC	CCC	....	X	....	....	CCC	CCC
Winter Banana	....	CCC	CCC	CCC	CCC	CCC	CCC	CCC	CCC	X	....	CCC	....	CCC	....	CCC
Yellow Transparent	....	CCC	CCC	X	CCC	CCC	CCC	CCC	CCC	CCC	....	X	....	CCC	CCC	....

.... Few or no fruits produced.
-p- Possibly as much as one-half full crop under good growth conditions.
CCC Fruitful combination—blooming season overlaps sufficiently.
X Combination should not be used without an additional pollinizing variety because blooming season may frequently not overlap sufficiently.
B. S. Unfruitful because blooming season does not overlap.

Certain other combinations are noted which would be only partially fruitful because there is not sufficient overlapping of the blooming period; for example, Stayman Winesap pollinated by Rome Beauty.

The material on blooming season in Table 1 is not to be taken arbitrarily. In the extreme southern portions of Ohio there is less overlapping of bloom of Rome Beauty with that of the earlier blooming varieties than in northern Ohio. For the relative blooming dates of apple varieties in Ohio consult Bulletin 472 of the Ohio Experiment Station.

PRECAUTIONS TO BE FOLLOWED IN PLANTING ORCHARDS

Certain varieties should be planted so that no tree is more than two rows (80 to 90 feet) from its pollinizing variety. This permits the planting of four rows adjacent if a suitable pollinizing variety is on each flank. The varieties requiring such special provision for thorough cross-pollination are:

- Arkansas (Mammoth Black Twig)
- Delicious, Starking, Richared
- Minkler
- Nero
- Ohio Nonpareil
- Paragon
- Rhode Island Greening
- Stayman, Stamared, Blaxtayman
- Tompkins King
- Turley
- Winesap

It has been suggested that McIntosh also be included in this group of varieties.

Suggestive planting plans for Stayman Winesap are given in Ohio Bulletin 483, Pages 49-50. The other varieties listed above should also be planted in accordance with similar plans.

In the case of the heavier setting varieties it is suggested that no tree be planted more than four rows (160-180 feet) from its pollinizer. The heavy setting varieties are:

- Baldwin
- Cortland
- Gallia Beauty
- Golden Delicious
- Grimes Golden
- Jonathan
- Northern Spy, Red Spy
- Oldenburg
- Rome Beauty, Red Rome
- Wagener
- Wealthy
- Winter Banana
- Yellow Transparent
- Yellow Imperial

POLLINIZING INSECTS FOR THE ORCHARD

There are many species of insects which serve as pollinizing agents, but the most important are honey bees, bumble bees, solitary bees, and other wild bees. In Ohio there are certain localities where sufficient wild bees are present to bring about effective cross-pollination, but it is unwise to depend on such bees unless one is certain of their abundance and of their efficacy in the particular locality. The introduction of hive bees into the orchard during bloom is a necessary practice in most orchards of the State.

NUMBER AND DISTRIBUTION OF COLONIES

One strong colony of bees per acre is recommended for a mature planting where other pollinizing insects, such as wild bees, are few or lacking. Distribution should be made throughout the orchard at a distance of every 200 feet each way. The colonies should be moved into the orchard a few days before the flowers are open in order that the bees may become accustomed to their new surroundings.

It is impossible to over-emphasize the importance of strong colonies. Recent work in New York has indicated that a strong colony is more effective in cold weather than a weak colony because of the greater number of bees flying at low temperatures from the strong colony.

SOURCE OF BEES

Strong colonies rented from a reliable beekeeper are undoubtedly the best. Where these cannot be obtained, recourse must be made to package bees. For directions in obtaining these and for their subsequent care, consult the proper bee specialists.

PRECAUTIONS TO BE FOLLOWED DURING BLOOM

1. Do not use arsenic or lead in any spray or dust during bloom. There is no justification in Ohio for such procedure.
2. Be careful in the use of arsenic and lead dusts if flowers of other plants, such as dandelions, are blooming in the orchards just preceding or during bloom.
3. Remove the bees from the orchard as soon as blooming has ceased.

PRECAUTIONS IN SPRAYING WITH SULFUR DURING BLOOM

Spraying just as the flowers are opening may produce undesirable effects. Experiments at Cornell University indicate that sulfur prevents pollen tube growth. Furthermore, sulfur appears to make the flowers distasteful to bees. The spraying should be delayed until after opportunity has been given for cross-pollination.

For further details on apple pollination consult the sections entitled "Practical Considerations" in the following bulletins:

Howlett, F. S. 1927. Apple Pollination Studies in Ohio. Ohio Agr. Exp. Sta. Bull. 404.

Howlett, F. S. 1931. Factors Affecting Fruit Setting. I. Stayman Winesap. Ohio Agr. Exp. Sta. Bull. 483.

NOTES ON THE TRUNK AND SHOOT PUBESCENCE OF EUROPEAN VARIETIES OF PLUMS

J. S. SHOEMAKER

The growing of many different varieties under approximately similar conditions in the "Plum Variety Orchard" at Wooster has provided an excellent opportunity to note distinguishing characters of both fruit and tree. This article serves to provide a record of observations on two characters of European plums (*Prunus domestica* and *P. insititia*) in the dormant season.

TRUNK BARK

The possibility that the trunks of European plum trees may be classified into two groups according to the characteristics of the bark does not seem to have been recognized generally in technical descriptions of varieties. The

classification given below was first made on trees of full-bearing age in the dormant season of 1925-1926; it was checked 8 years later. The bark of the European species is, of course, markedly different with respect to trunk characters from that of the native and Japanese species.

GROUP 1

Bark of trunk with fairly deep, vertical fissures—

Large-fruited European varieties: Yellow Egg, Bradshaw, General Hand, French Prune, Giant, Pond, McLaughlin, Peters, Victoria, Shipper, Gueii, Imperial Epineuse, Standard, Pearl, Thanksgiving Prune, Conquest.

Damsons: Shropshire, Majestic, Sweet, Big Mackey, Finch, Prune Damson, Crittenden (Farleigh), Early Mirabelle.

GROUP 2

Bark of trunk relatively smooth—

Large-fruited European varieties: Lombard, Grand Duke, Beauty of Naples, Arctic, Tragedy, German Prune, Italian Prune, Jefferson, Imperial Gage, Arch Duke, Reine Claude, Palatine, Clyman, Sannois, Hall.

Damson varieties: Pringle, White, French, Merryweather, Kelso, Deck, Musselman, Riley, Mt. Logan, Scioto, Bradley, Langley Bullace.

Fig. 1.—Bark of trunk of European plum with deep vertical fissures (left) and relatively smooth (right)

The above grouping requires more explanation than is given by the general headings. The bark on the trunk of all varieties in Group 2 is not so smooth as that shown in the illustration. With members of this group, splits in the bark commonly occur in a horizontal position; vertical, crack-like depressions may be apparent, but they are practically always on the southwest side of the trunk; occasionally, splits or cracks occur on the north side of the trunk but these do not seem to be due to conditions which are normally characteristic of the variety. A little preliminary practice has enabled good agreement on

the grouping of the varieties to be made by several persons working independently on these trees. Perhaps, under conditions that are different from those under which the observations were made, some of the varieties may appear different in trunk characters than they do at Wooster. The notes were made only on trees whose diameter exceeded 6 inches; young trees cannot be classified properly into the two groups.

SHOOT PUBESCENCE

Shoot pubescence of plums is of value in checking the trueness to name of both nursery and orchard trees and as a supplement to other characters in identifying varieties. It is a useful character in both the dormant and growing seasons.

GROUP 1

Shoots markedly pubescent (hairy)—

Large-fruited European varieties: Monarch, Gueii, Washington, Shipper, Conquest, Imperial Gage, Tragedy, Diamond, Victoria, Thanksgiving Prune, Glass, Field, Clyman.

Damson varieties: Shropshire[1], Prune Damson, Pringle, White, Early Mirabelle.

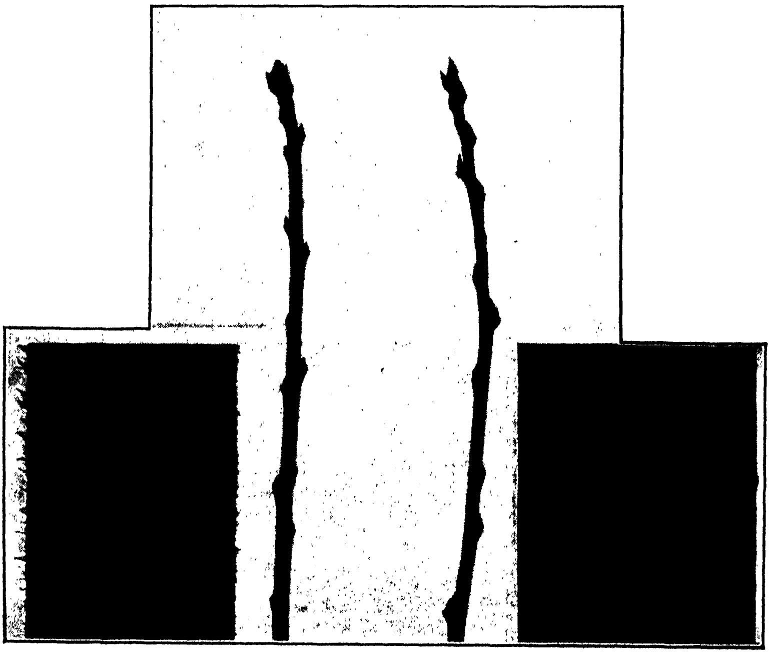

Fig. 2.—European plum shoots—hairy (left), with close-up of same (inset), and smooth (right)

[1]The pubescence of Shropshire Damson at Wooster is not so heavy as on other varieties in the group and only slightly more so than on French Damson. Some correspondence has indicated the possibility that the Shropshire commonly grown in Ohio, even though it is of considerable value, may not be identical with the Shropshire grown in England where it originated.

GROUP 2

Shoots lightly pubescent or nearly glabrous—

Large-fruited European varieties: Reine Claude, German Prune, Italian Prune, Pond's Seedling, Imperial Epineuse, Bradshaw, Giant, Grand Duke, Yellow Egg, General Hand, McLaughlin, Peters, Jefferson, Crimson Drop, Austrian Prune, French Prune, Standard Prune, Maloney, Robe de Sergeant, Hall, Lombard, Stanley, Sannois, Yakima, Arch Duke, Vacaville, Pacific.

Damson varieties: Riley, Kelso, Scioto, French, Musselman, Deck, Sweet, Finch, Crittenden, King (Bradley), Early Rivers, Langley Bullace.

The kind of shoot pubescence on European-type plums is as definitely characteristic of a variety as is the white or yellow flesh of a peach variety. Neither shoot pubescence nor flesh color is a sufficient guide to the identification of a variety; however, in conjunction with other characters it is a help in distinguishing between varieties. In detecting mixtures in nursery trees, shoot pubescence is a handy character to use when walking along the rows. Usually, in the nursery, single tree mixtures have been found to be direct growth from the rootstock; whereas, when budding has been successful, mixing of varieties in the row (in cases where it has occurred) has usually been represented by the number of trees from one or more budsticks. In the dormant season, shoot pubescence, together with color and other differing characters of the shoots, has provided a useful check when cutting scions for grafting and in detecting mixtures in the storage and packing house.

IRON IN THE DIETS OF PRE-SCHOOL CHILDREN

HUGHINA McKAY

Because there is little reserve iron in the body and because, although iron is widely distributed among foods, it is present in small amounts, it seems necessary to take some care to assure an adequate daily supply in the diet. This is especially true for young children. Their iron need is relatively greater than that of adults. In addition, the fact that young children should have a generous percentage of their total daily calories from milk, which (although it is the "most nearly perfect food") contains little iron, necessitates some care in the selection of foods which, with the iron of milk, will supply an amount adequate for their needs.

There are few figures to show even approximately how much iron young children receive in their diets. A dietary study reported by McKay (1) showed the amount of iron in the diets of 55 pre-school children. A study of the mineral intake, including iron, of 38 well-nourished adolescent girls has recently been reported by Roberts and Wait (2). Two iron balance studies, one by Rose and co-workers (3) on a girl of 31 months and the other by Leichsenring and Flor (4) on one boy and three girls from 35 to 56 months, have been reported.

1. McKay, H. 1926. Ohio Agricultural Experiment Station Bulletin 400.
2. Roberts, L. J. and Wait, B. 1933. The Journal of the American Dietetic Association 9: 124.
3. Rose, M. S., Vahlteich, E. McC., Robb, E., and Bloomfield, E. M. 1930. The Journal of Nutrition 3: 229.
4. Leichsenring, J. M. and Flor, I. H. 1932. The Journal of Nutrition 5: 141.

TABLE 1.—Average Daily Iron Intake, in Milligrams, of Pre-school Children

Child	Age	First year				Average for year	Age	Second year				Average for year
	Months	Winter	Spring	Summer	Autumn		Months	Winter	Spring	Summer	Autumn	
I	16-28	....	....	5.989	7.537	6.763	28-40	7.465	7.507	7.955	9.070	7.999
II	19-31	5.886	....	5.967	5.897	5.917	31-43	7.350	6.443	7.650	7.923	7.342
III	19-31	7.655	6.666	7.215	7.664	7.300	31-43	7.836	8.489	8.778	7.699	8.200
IV	20-32	5.123	7.236	6.175	7.074	6.402	32-44	6.701	9.374	7.530	8.471	8.019
V	24-36	4.886	5.389	3.949	5.962	5.047	36-48	6.254	....	....	....	....
VI	26-38	8.520	8.602	8.702	7.916	8.435	38-50	9.220	9.682	10.024	9.483	9.602
VII	29-41	7.014	7.482	9.656	8.873	8.256	41-53	9.258	7.574	9.764	10.977	9.393
VIII	35-47	7.201	7.202	5.261	8.117	6.945	47-59	7.211	6.607	8.082	9.924	7.956
IX	40-52	8.156	8.466	6.982	8.240	7.961	52-64	8.489	7.622	10.492	9.311	8.978
Average	....	6.805	7.292	6.738	7.476	7.003	....	7.754	7.912	8.784	9.107	8.436

TABLE 2.—Average Daily Iron Intake, in Milligrams, per 100 Calories

Child	Age	First year				Average for year	Age	Second year				Average for year
	Months	Winter	Spring	Summer	Autumn		Months	Winter	Spring	Summer	Autumn	
I	16-28	....	....	0.598	0.606	0.602	28-40	0.598	0.569	0.643	0.685	0.624
II	19-31	0.493	....	0.544	0.424	0.487	31-43	0.520	0.538	0.604	0.551	0.553
III	19-31	0.649	0.595	0.690	0.636	0.642	31-43	0.655	0.659	0.721	0.628	0.666
IV	20-32	0.501	0.652	0.635	0.602	0.598	32-44	0.667	0.772	0.753	0.700	0.723
V	24-36	0.460	0.498	0.414	0.510	0.470	36-48	0.615	....	....	....	....
VI	26-38	0.688	0.601	0.671	0.643	0.651	38-50	0.671	0.645	0.812	0.718	0.712
VII	29-41	0.517	0.588	0.632	0.641	0.594	41-53	0.672	0.600	0.658	0.687	0.654
VIII	35-47	0.534	0.517	0.449	0.581	0.520	47-59	0.553	0.521	0.717	0.622	0.603
IX	40-52	0.624	0.718	0.605	0.618	0.641	52-64	0.632	0.537	0.735	0.685	0.647
Average	....	0.583	0.596	0.582	0.585	0.578	....	0.620	0.607	0.705	0.660	0.648

As part of a study made by the writer of the food intake of a small group of children during a 7-day period for each of the four seasons of the 2 years 1932 and 1933, the iron in the diets of nine pre-school children has been computed. A brief summary of the results of this computation is herein reported. The most recently reported figures, including those given by Stiebeling (5), were used for the computations. Concerning fruits and vegetables, Sherman (6) states, "In many cases the new general averages are the results of analyses of so many samples that they are not likely to be much changed by future work".

Bassett, Elden, and McCann (7), using figures from tables given by Sherman (6), computed the iron content of 10 diets composed of a variety of foods and then analyzed the same 10 diets for iron. They found a close agreement between the two sets of figures. On the other hand, Rose (3) and Leichsenring (4) report that computed iron figures for diets used by the children they studied were from 24 to 35 per cent higher than corresponding figures when the diets were analyzed. The differences in analyzed and computed values for iron in the diets of these children serve to emphasize the importance of providing generous amounts of those foods which provide liberally for the iron needs of children.

Table 1 shows the results of the calculations of total average iron intakes in the diets of the nine pre-school children. Table 2 shows the iron used per 100 calories. As might be expected, the trend is toward an increased iron intake with increasing age. Without exception, every child in the group averaged more iron during the second than during the first year in spite of the fact that the average calorie intakes for each child were increased somewhat but not significantly during the second year.

On the other hand, among individual children, iron intake did not increase consistently with age; that is, the older children did not all have higher iron intakes than the younger children, although the trend is in that direction. Of the nine children for whom figures are given for the first year, the youngest, Child I, aged 16 months at the beginning of the study, averaged approximately the same amount of iron daily during each of the 2 years as did Child VIII, with a corresponding age of 35 months.

On the basis of milligrams of iron per 100 calories, the yearly average of Child I exceeded the yearly average of four older children, as well as the yearly average of the group during the first year. Although his iron per 100 calories was greater the second year, the iron intakes of the other children increased proportionately and his yearly average intake was somewhat lower than that of the group but still exceeded that of Child VIII.

Increased amounts of iron in the diet of children as they become older are due not only to the fact that they eat more food (although with this group of nine children the increase in food intakes was not marked) but also to the fact that as they grow older they have a wider variety of food. In the main, they use more fruits and vegetables. The amount of iron per 100 calories indicates this change in food habits. As shown in Table 2 every child increased the milligrams of iron per 100 calories used during the second year, the increase ranging from one to 21 per cent.

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5. Stiebeling, H. K. 1932. U. S. Department of Agriculture Circular No. 205.
6. Sherman, H. C. Chemistry of Food and Nutrition, fourth edition. 1932. The MacMillan Company. p. 330.
7. Bassett, S. H., Elden, C. A., and McCann, W. S. 1931. The Journal of Nutrition 4: 235.

During the first year, three of the children each averaged 0.52 milligrams or less of iron per 100 calories daily. To determine, if possible, what food habits were responsible for these low iron intakes, all foods used were divided into groups as follows: 1, milk; 2, cereal grains; 3, fruits and vegetables; 4, fats and oils; 5, sugars and other sweet foods; 6, eggs; 7, meats and other high-protein foods. Then, the percentage of total calories derived from each of these groups was determined for each child.

Two of the three children whose iron intakes were low averaged 22 per cent of their entire calorie intake from fats and sugars. These two food groups provide little or no iron, and, as the amounts increase proportionally in the diet, the provision for iron obviously decreases. From 5 to 12 per cent of total calories from fats and sugars has been suggested as a good standard. These two children were having about twice the amount of the desired standard. Without exception, the iron intake per 100 calories increased during the second year. Part of this increase may be assumed to be due to the decreased proportion of fats and sugar in the diet, the average for the first year being 18 per cent as compared to 16 per cent for the second year.

The third child, whose iron intake was low, obtained about 14 per cent of his total calories from sugar and fat and, in addition, was using small amounts of fruits and vegetables, only 13 per cent of his calories coming from this food group as compared with 16 to 22 per cent suggested as a desirable standard and with 21 per cent used by one of the children whose iron intake was high.

The group as a whole increased fruit and vegetable consumption from an average of 18 per cent of total calories derived from this group during the first year to 21 per cent so derived during the second year. Average iron intakes increased during the same period from 0.58 to 0.65 milligrams per 100 calories.

During both years, the effect of the generous use of egg on the amount of iron in the diet is shown. Children using liberal amounts of egg, as shown by calories derived from it, were among the children having most liberal iron intakes, as indicated by milligrams of iron per 100 calories.

TABLE 3.—Percentage of Iron Derived from Food Group for Each Year

	First year		Second year	
	Range	Average	Range	Average
Milk	18-36	23	15-28	21
Cereal grains	11-25	16	7-15	13
Fruits and vegetables	31-48	39	33-48	43
Meat and eggs	7-30	21	16-38	21

Table 3 shows the proportion of total iron contributed by the various food groups. Although milk is considered a poor source of iron, it furnished a surprisingly large proportion, an average of about one-fourth of the total iron of the children's diets. A study of the diets of 25 pre-school children living in private homes, as reported by McKay (1), showed that 80 per cent of the children were getting one-fourth or more of their iron from milk. Workers in Sherman's laboratory have shown that young rats had a better store of body iron when fed on a wheat and milk mixture in which the milk was liberally supplied than when the proportion of wheat was increased or when meat was

substituted for part of the wheat-milk mixture, even though such substitutions increased the amount of iron in the diet. The reason for this is not evident, but Sherman stresses the importance of recognizing the fact that the "iron values" of some foods may be greater than the "iron contents" would imply (9). This is undoubtedly true for milk.

There is a liberal proportion of iron in the cereal grains, but the common practice of using the highly milled products rather than the entire grain with the outer coats and embryo lessens the value of this food group as a source of iron. Although a few of the nine pre-school children averaged about one-fourth of their iron from this food group, the average of the group as shown in Table 3 was much less. Considering the fact that milk and the cereal grains, the foods which form the basis of the child's diet, furnished in these cases an average of from only 34 to 39 per cent of the total iron, the importance of fruits and vegetables in the diets of the nine children is evident, since this food group furnished an average of from 39 to 43 per cent of the entire iron used. In this connection, it may be of interest that as far as this one food group is considered these children were well up to the standard suggested by Rose (10) and also that during the second year when the percentage of calories provided by fruits and vegetables increased the milligrams of iron per 100 calories increased also.

Although the iron provided by meat, eggs, and other foods high in protein averaged 21 per cent of the total iron used by the group during each of the two years, the range of from 7 to 30 per cent for the first year and from 16 to 38 per cent for the second year was greater than the corresponding range for any of the other food groups.

During the first year of the study none of the nine children had as much as 0.75 milligram of iron per 100 calories, the tentative standard for pre-school children suggested by Rose (3). One child averaged 0.77 and 0.75 milligrams per 100 calories, respectively, for each of two seasons during the second year.

During the first year four of the nine children had approximately the 0.62 milligram per 100 calories suggested by Leichsenring and Flor (4) as a tentative standard. Six of the eight children exceeded this standard the second year, one had an amount equal to the standard, and one had less.

The averages for each year exceeded the milligrams of iron per 100 calories used by the adolescent girls whose mineral intakes were reported by Roberts and Wait (2).

Although the figures for iron intakes as shown by the present study are too few in number to be used in setting standards of iron allowances desirable for pre-school children, they do show trends and, used in connection with the figures of iron-balance experiments, may be serviceable.

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8. Sherman, H. C. 1926. Chemistry of Food and Nutrition. p. 587.
9. Sherman, H. C. 1932. Chemistry of Food and Nutrition. pp. 321-322.
10. Rose, M. S., Robb, E., and Borgeson, G. M. 1932. Child Development 3: 29.

THE ORIGIN OF LIVESTOCK AND DISTANCE TRANSPORTED BY TRUCK TO CLEVELAND FROM OHIO

GEO. F. HENNING

Although livestock trucking has increased by leaps and bounds, its real importance is not realized until the origin of the truck receipts is examined, Figure 1. The trucker in 1932 was transporting livestock to Cleveland from all over northern Ohio. Approximately 25 counties around Cleveland furnished most of the cattle and calves and about 12 counties southwest of Cleveland furnished the bulk of the hogs. The major portion of the sheep truck receipts came from the same counties as did the hogs.

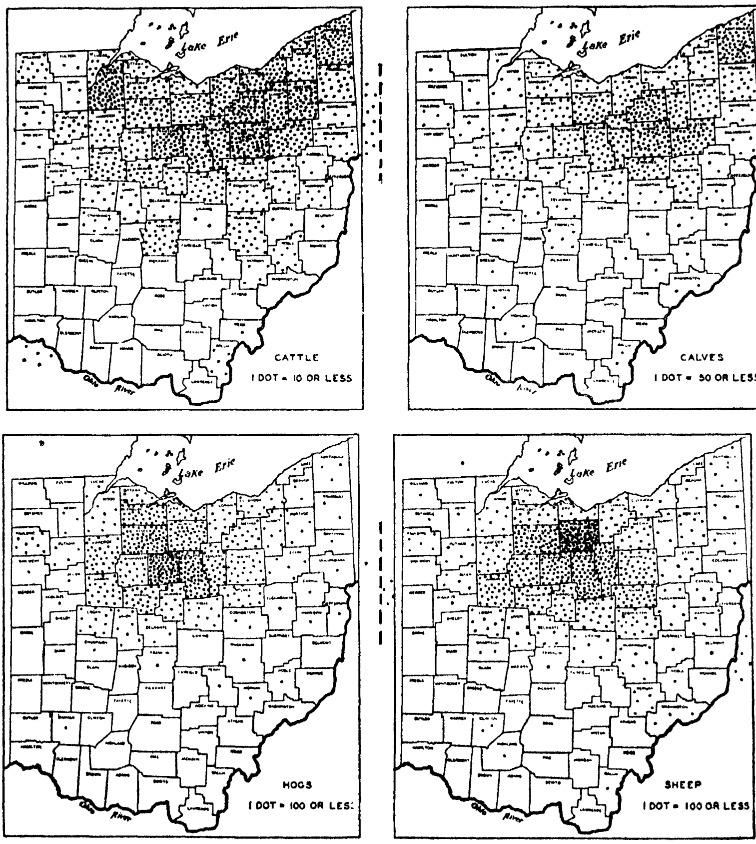

Fig. 1.—The origin of livestock trucked to Cleveland for the months of January, April, July, and October, 1932

When the charts showing the origin of truck receipts at Cincinnati are examined[1], it is observed that the areas for hogs and calves are more concentrated than the area trucking to Cleveland. Cattle and sheep, however, are trucked in from more distant points. Large truck receipts of lambs were sent

[1]They are not included in this bulletin in order to conserve space and reduce expense.

to Cincinnati from Clark County. However, this large concentration was due principally to the large number of lambs fed on contract for a packer in Cincinnati. One reason why truck receipts to Cincinnati do not extend farther from the market is because of hauling livestock against the normal movement, which is to eastern markets. Then, too, competition arises from Dayton, located in Montgomery County, and Columbus, located in Franklin County. These two small markets have a tendency to keep the area more concentrated near Cincinnati. In order to obtain this information for Cleveland it was necessary to examine the records and to classify the receipts by counties according to the location of post offices. Consequently, only 4 months were selected, representing the different seasons of the year. By obtaining the post offices for the truck receipts and then ascertaining the road mileage distance from the stockyards, it was possible to show the distance livestock was trucked to Cleveland. These results are shown in Table 1. Beyond the 20-mile zone cattle truck receipts were quite uniform per zone, reaching a maximum at the 50- to 60-mile zone, which accounted for 10.6 per cent of the total cattle receipts by truck. The zones between 40 and 90 miles contributed the most livestock, although the zone above 100 miles was a heavy one. The same description also applies to calves; but for hogs the zones between 50 and 110 miles furnished the bulk of the receipts. In fact, 67 per cent of the hog receipts by truck came from these zones. The same was true for sheep, with about the same percentage for the six zones, 66.7 per cent.

TABLE 1.—The Number and Percentage of Livestock Trucked to Cleveland, by Zones of 10 Miles, for January, April, July, and October, 1932

Miles from Cleveland	Number				Percentage			
	Cattle	Calves	Hogs	Sheep	Cattle	Calves	Hogs	Sheep
Under 10	90	169	224	495	0.7	0.5	0.4	0.7
10— 19	246	524	1796	247	2.1	1.7	3.1	0.3
20— 29	821	1576	1045	859	7.0	5.0	1.8	1.2
30— 39	683	2388	1176	1503	5.8	7.6	2.0	2.1
40— 49	897	2649	2559	3793	7.7	8.4	4.4	5.3
50— 59	1240	4245	5470	9239	10.6	13.5	9.4	12.9
60— 69	1145	4878	5625	7963	9.8	15.6	9.6	11.2
70— 79	1163	5624	7435	10390	10.0	17.9	12.7	14.6
80— 89	631	2299	6954	5822	5.4	7.3	11.9	8.2
90— 99	783	2088	7725	8961	6.7	6.7	13.2	12.6
100—109	1127	960	6280	5165	9.7	3.1	10.8	7.2
110—119	557	311	1523	3574	4.8	1.0	2.6	5.0
120—129	366	573	2029	2540	3.1	1.8	3.5	3.6
130—139	531	675	3692	3136	4.6	2.2	6.3	4.4
140—149	586	1014	2479	3352	5.0	3.2	4.2	4.7
150—over	823	1397	2390	4257	7.0	4.5	4.1	6.0
Total	11,689	31,370	58,402	71,296	100.0	100.0	100.0	100.0

It is rather significant to note the amount of livestock which is trucked to the Cleveland market beyond the 100-mile zone—34.2 per cent of the cattle, 15.8 per cent of the calves, 31.5 per cent of the hogs, and 30.9 per cent of the sheep. Although the greatest amount of livestock for each zone of 10 miles came from 50 to 100 miles from Cleveland, a considerable amount came from those zones from 100 to 150 miles. This would seem to indicate that during the next few years the increase in trucking, if in any considerable quantity, may be expected in the zones beyond 100 miles.

TABLE 2.—The Number and Percentage of Livestock Trucked to Cleveland, by Zones of 10 Miles, for October in 1922, 1928, and 1932

Miles	Cattle			Calves			Hogs			Sheep		
	1922	1928	1932	1922	1928	1932	1922	1928	1932	1922	1928	1932
Number received												
Under 10	51	104	20	30	124	24	20	95	16	9	45	343
10—19	179	200	61	147	132	169	178	230	390	119	276	138
20—29	164	337	318	183	272	485	389	357	316	293	507	408
30—39	151	745	159	458	817	528	631	1358	254	1104	2557	413
40—49	41	631	199	277	763	606	1046	1169	687	1508	3076	1115
50—59	12	509	282	25	684	1198	504	2005	1432	772	2962	2864
60—69	3	279	218	32	803	1115	61	3268	1731	169	3146	3252
70—79	19	54	248	0	115	1086	9	963	2313	0	1460	3356
80—over	4	24	1401	15	102	2194	19	695	11386	61	647	12407
Total	624	2,883	2,906	1,167	3,812	7,405	2,857	10,140	18,525	4,035	14,676	24,296
Percentage received												
Under 10	8.2	3.6	0.7	2.5	3.2	0.3	0.7	0.9	0.1	0.2	0.3	1.4
10—19	28.7	6.9	2.1	12.5	3.5	2.3	6.2	2.3	2.1	2.9	1.9	0.6
20—29	26.3	11.7	10.9	15.6	7.1	6.5	13.2	3.5	1.7	7.3	3.5	1.7
30—39	24.2	25.8	5.5	39.2	21.4	7.1	22.2	13.4	1.4	27.3	17.4	1.7
40—49	6.6	21.9	6.9	23.6	20.0	8.2	36.6	11.5	3.7	37.4	20.9	4.6
50—59	1.9	17.7	9.7	2.1	17.9	16.2	17.6	19.8	7.7	19.2	20.3	11.8
60—69	0.5	9.8	7.5	2.7	21.1	15.0	2.1	32.2	9.3	4.2	21.4	13.4
70—79	3.0	1.8	8.5	0.5	3.0	14.7	0.3	9.5	12.5	0.0	9.9	13.8
80—over	0.6	0.8	48.2	1.3	2.8	29.7	0.7	6.9	61.5	1.5	4.4	51.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

To show how the trucking zones[2] have expanded, Table 2 is presented. The month of October was used for comparison. One month may seem like a small sample, but the percentage comparisons for 1932, by zones, for each species vary little from percentages in the preceding table, which included 4 months—January, April, July, and October.

The change which has taken place in the zone beyond 80 miles is of most significance in this table. Cleveland was receiving less than 1 per cent of the truck cattle receipts in 1928 beyond the 80-mile zone, but in 1932 this percentage was 48.2. For calves the percentages increased from 2.8 per cent to 29.7 per cent; for hogs, from 6.9 per cent to 61.5 per cent; and for sheep, from 4.4 per cent to 51 per cent. Four years ago Cleveland was receiving the bulk of the truck receipts under 60 miles. In 1932 the majority of the truck receipts, except for calves, was coming from localities more than 70 miles distant. As noted in the previous table, 5 per cent or more came a distance of more than 150 miles.

This table points out the important shift taking place in the transportation of livestock during the past few years. Truck receipts have been increasing. Rates for trucking livestock have been declining, more good all-weather roads have been added, the costs of truck operations have been lowered, and the farmer has been receptive of the truck. The obvious result is shown in Tables 1 and 2—an expansion of the trucking territory.

[2]The information for the years 1922 and 1928 was taken from Bulletin 440 of the Ohio Agricultural Experiment Station, "The Truck and Its Relationship to Livestock Marketing in Ohio".

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

The year 1933 ended with all items in the table, except the wages of farm labor, at a higher level than one year ago. In December of 1933 the Ohio farmer was receiving prices 18 per cent higher than a year ago; on the other hand, he was paying 15 per cent more for what he purchased. From July to December of 1933 there was a continual decline in the prices of Ohio farm products. For the full year, however, it is estimated that the cash income from the sales of farm products of the State was $164,000,000 in 1933, as compared with $144,000,000 in 1932.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	...	100	100	104	100	105	100
1914	99	100	101	102	102	102	105	107
1915	102	101	106	100	103	107	106	110
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	141	232	156	139	169	96	154	147
1929	139	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	128	130
1931	107	207	129	80	120	82	89	93
1932	95	178	110	57	92	70	63	67
1933	96	...	108	63	74	59	69	75
1932								
January	98	191	115	63	100	...	69	81
February	97	189	114	60	...	...	64	68
March	96	189	112	61	...	70	64	67
April	95	183	111	59	94	...	64	65
May	94	177	109	56	...	...	61	63
June	93	174	108	52	...	...	59	61
July	94	171	107	57	90	...	63	67
August	95	172	107	59	...	...	66	73
September	95	177	106	59	...	...	64	67
October	94	177	105	56	84	...	61	68
November	93	171	104	54	...	...	61	56
December	91	170	103	52	...	...	60	59
1933								
January	89	164	102	51	75	...	55	62
February	87	164	101	49	...	...	53	61
March	88	163	100	50	...	59	53	54
April	88	165	101	53	70	...	59	60
May	92	169	102	62	...	...	71	72
June	95	172	103	64	...	...	70	82
July	100	176	105	76	73	...	83	96
August	102	176	112	72	...	...	79	93
September	103	179	116	70	...	...	79	85
October	104	177	116	70	77	...	78	88
November	104	175	117	71	...	...	77	83
December	103	...	118	68	...	...	71	74

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WOOSTER, OHIO, U. S. A.

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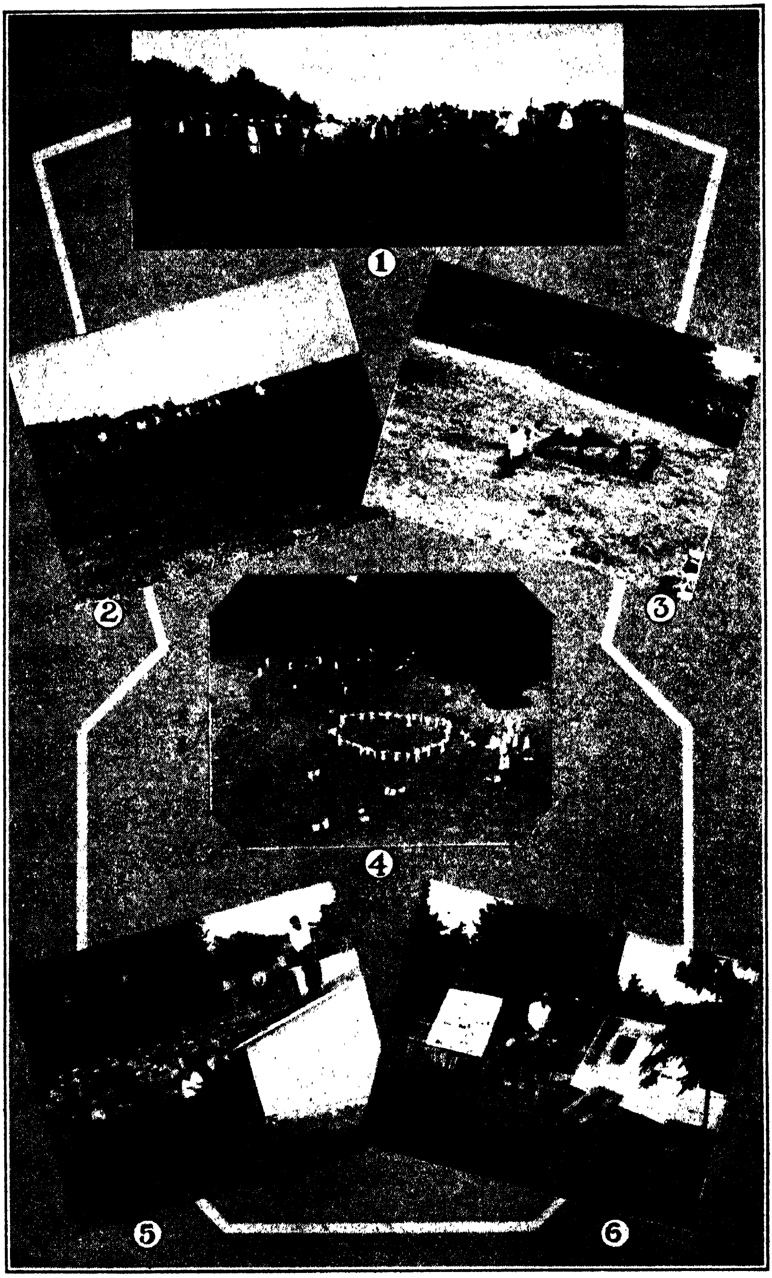
Free Bulletin

C. G. Williams

Director



Scenes on Special Days at the Ohio Experiment Station.

See Page 134 for Schedule for 1934

SHALL THE CHICKS AND GROWING PULLETS BE RANGED OR CONFINED?

D. C. KENNARD AND V. D. CHAMBERLIN

Contaminated soil has been held responsible for many of the ills of chicks, growing pullets, and layers. If this were true, the obvious solution would seem to be either to raise the chicks and pullets each year on fresh, uncontaminated range or to confine them indoors or to wire sun porches. Consequently, many poultry raisers have made great efforts to provide fresh, clean range; whereas others have endeavored to accomplish the same object at considerable expense by growing their pullets in confinement. Are these efforts and this expense justified?

Each year the poultry raiser faces the proverbial range problem. Fortunate are those who operate on a 2- or 3-year range rotation so that a fresh range awaits the new crop of pullets each year. For many this is impracticable; hence, they are obliged to take their chances with last year's range or a questionable range which has been run over by mature birds or otherwise exposed to their infections. To avoid the liabilities of a contaminated range, many resort to raising the chicks and growing the pullets in confinement. How do pullets raised on contaminated range, fresh range, and in confinement compare during the growing period and as layers? This Station has been testing different methods of managing growing pullets during the past 5 years in an endeavor to secure information bearing on these questions.

TESTS WITH THE GROWING OF CHICKS AND PULLETS AND THEIR PERFORMANCE AS LAYERS

When range paralysis made its first appearance among the Station's flocks in 1928, it was thought that disease-contaminated ranges might be largely responsible. Pursuant of this idea, tests were started to compare the growth of chicks and pullets in confinement with similar chicks and pullets grown on fresh range. The first tests to be considered are those which were conducted for 4 years by L. A. Malik, in charge of the Northeastern Experiment Farm at Strongsville; the results are given in Tables 1 and 2.

The chicks were housed and managed alike, except that one group was confined to the 10 x 12-foot colony brooder house with a 6 x 10-foot wire sun porch whereas the other had free access to an unlimited fresh range after the first 2 or 3 weeks, with the exception of the last test in 1932. In this test both groups were brooded in confinement for 12 weeks, and then the pullets were equally divided—one group being continued in confinement while the other was given fresh range.

The rate of maturity, insofar as egg production or date of first egg is concerned, was practically the same for both groups for each of the 4 years. Except for the second year, the mortality of the confined birds was less than that of the birds on range. The confined pullets weighed less when housed, except for the first year, and even then these pullets averaged less in weight in the laying house than the ones grown on range. The behavior and performance of the eight different groups of pullets as layers will be found in Table 2.

TABLE 1.—Growth of Pullets in Confinement Versus Range Northeastern Experiment Farm, Strongsville, Ohio

Test and date		Chicks	Date hatched	Eggs: Date of first egg	Eggs: Before pullets housed	Mortality	Average weight of pullets
		No.				*Per cent*	*Pounds*
1—1929	Confined..........	220	March 28	August 7	334	12.3	3.29
	Ranged...........	220	March 28	August 24	71	17.0	3.18
2—1930	Confined..........	414	March 23	August 7	802	16.0	3 07
	Ranged...........	404	March 23	August 9	1098	13.0	3.48
3—1931	Confined..........	399	April 22	Sept. 18	....	9.5	2.64
	Ranged...........	398	April 22	Sept. 20	....	14.0	2.70
4—1932	Confined..........	140*	April 22	Sept. 3	....	4.3	2.86
	Ranged...........	140*	April 22	Sept. 7	....	10.7	2.97

*All chicks brooded in confinement until July 13, when pullets were divided equally into two groups of 140 each. One group continued in confinement, while the other group was transferred to a fresh range.

The confined pullets were housed each year as layers in half of a 20 x 40-foot laying house and continued to have access to a wire-screen sun porch 10 x 20 feet.[1] The ranged pullets were housed in the other half of the laying house with access to a good, unlimited range throughout the year. The range was divided and alternated each year.

TABLE 2.—Confinement Versus Range for Laying Pullets Northeastern Experiment Farm, Strongsville, Ohio

Test and date	Pullets housed	Date housed	Duration of test	Eggs per bird: To March 1	Eggs per bird: Total	Mortality: Paralysis	Mortality: Cannibalism	Mortality: Total	Average weight per bird
	No.		*Weeks*			*Per cent*	*Per cent*	*Per cent*	*Pounds*
1—1929-30									
Confined*....	72	Sept. 12	50	66	169	5.5	15.3	50.0	3.44
Range†......	61	Sept. 12	50	73	186	16.4	....	53.0	3.65
2—1930-31									
Confined.....	119	Sept. 20	46	72	168	1.0	10.8	29.0	3.30
Range.......	120	Sept. 20	46	73	162	14.2	2.5	27.0	3.53
3—1931-32									
Confined.....	120	Sept. 3	50	70	161	20.0	....	53.0	3.66
Range.......	120	Sept. 3	50	74	165	27.0	....	52.0	3.77
4—1932-33									
Confined.....	115	Sept. 1	30‡	....	64	6.0	....	20.0	3.94
Range.......	115	Sept. 1	30	....	71	12.0	....	24.0	4.15

*Chicks and pullets brooded and grown in colony house with wire sun porch and continued in similar confinement in laying house.
†Chicks and pullets brooded and grown in colony house which was moved to fresh range each year. These pullets as layers were continued on a good range.
‡Test discontinued March 29, owing to reduced budget for labor.

In the matter of egg production, there was no significant difference. The total mortality of both groups during each of the 4 years was much the same. However, if the preventable loss from cannibalism during the first 2 years of

[1]Except in the last test of 1932-1933, when the confined group was housed in good quarters in a barn without access to sun porch or out-of-doors.

the confined groups be deducted, the mortality from other causes was considerably less. Particularly was this true of paralysis. This offered encouragement as a preventive of paralysis during the first 2 years but was disproved by subsequent tests. It is interesting to note the heavy loss of confined pullets from cannibalism during the first 2 years which was avoided afterwards by special care and management.

As layers, the average weight of the pullets raised in confinement was considerably less each of the 4 years. Whether this might indicate a superiority of the range pullets we are unprepared to say.

TESTS WITH THE GROWTH OF CHICKS AND PULLETS AND PERFORMANCE AS LAYERS AT WOOSTER

A more comprehensive test was conducted at Wooster in which different kinds of confinement and range were involved, including wire sun porch, wire sun porch and colony house fly-screened, contaminated range, fresh range, and the brooding of chicks and growth of pullets in batteries. By contaminated range is meant one on which the pullets are ranged year after year. Although mature chickens did not frequent this range, the pullets were more or less exposed to mature birds by coming in contact with the droppings under a wire-screen sun porch used by hens and some of the pullets frequented a storage of droppings from laying houses. By fresh range is meant a different blue-grass range each year where no birds have been for at least 2 years. The wire-screen sun porch was 6 x 10 feet in connection with a 10 x 12-foot colony brooder house. The wire-screen sun porch was floored with ¾-inch square mesh hardware cloth and enclosed with wire netting. The chicks were all brooded in a battery brooder until 8 weeks old the first year and until 5 weeks the second year. They were then transferred to the colony brooder houses; thus, they were 10 and 7 weeks old, respectively, before being subjected to the different methods of management. When these different groups of pullets were tested as layers, they were housed, fed, and managed the same. The first 2 years' results of these tests with the growth of pullets are recorded in Table 3.

TABLE 3.—Confinement Versus Ranges for Growth of Pullets Wooster, Ohio

Management	Year	Pullets	Date hatched	Eggs		Mortality	Average weight per bird Nov. 20
				First egg	Before housed		
		No.				*Per cent*	*Pounds*
Open-wire sun porch	1930	40	May 12	Nov. 2	20	5.0	2.92
	1931	50	May 20	Nov. 6	113	14.0	3.45
Fly-screened sun porch and brooder house	1930	40	May 12	Nov. 4	55	5 0	3.03
	1931	50	May 20	Nov. 5	111	8.0	3.21
Contaminated range	1930	40	May 12	Nov. 9	32	7.5	2.96
	1931	50	May 20	Nov. 1	195	4.0	3.36
Fresh range	1930	40	May 12	Nov. 9	32	20.0	2.93
	1931	50	May 20	Nov. 1	251	10.0	3.56

The rate of maturity, as indicated by the number of eggs laid before the pullets were transferred to laying quarters, was practically the same in 1930; whereas the range groups were somewhat more forward in production the

second year. The mortality differed little among the different groups both years, except for the group on fresh range in which the mortality was greater than in the other groups. However, this can hardly be regarded as significant. The average weight of the different groups of pullets was similar in the first test, but the range pullets were heavier in the second year's test.

The behavior and performance of these different groups of pullets, which were all treated the same, as layers are recorded in Tables 4 and 5.

TABLE 4.—Range Versus Confined Layers
November 20, 1930—September 24, 1931
(44 weeks)

Management	Pullets	Eggs per bird	Mortality				Body weight
			Paralysis	Cannibalism	Colds, roup, pox, etc.	Total	
	No.	*No.*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Pounds*
Sun porch	38	151	5.3	....	13.0	42.0	3.33
Fly screen	34	128	....	....	24.0	62.0	3.13
Contaminated range	34	131	8.8	....	41.0	68.0	3.23
Fresh range	31	142	16.2	3.2	13.0	50.0	3.50

In Table 4 it will be observed that the sun-porch pullets led in production. The low production and higher mortality of the fly-screen group cannot be accounted for unless, perchance, the layers were more susceptible to the infections carried by flies because they had not built up a resistance to these infections. This may be substantiated by the fact that they were more subject to colds, roup, and pox. The higher mortality from these causes of the pullets grown on contaminated range would seem to incriminate the range. The fact that no paralysis was observed in this test among the fly-screened pullets is interesting (but this was not so in subsequent tests); whereas the greatest loss from paralysis in the fresh-range group is baffling. The weight of the fresh-range birds was distinctly greater.

TABLE 5.—Confinement Versus Range for Layers in Individual Cages
December 5, 1931—August 22, 1932
(36 weeks)

Management	Pullets	Eggs per bird	Mortality				Average weight of birds
			Paralysis	GWD*	Colds, roup, pox	Total	
	No.	*No.*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Pounds*
Sun porch	24	132	4.0	17.0	....	33.0	3.74
Fly screen	24	129	12.5	8.5	....	21.0	3.59
Contaminated range	24	102	8.0	38.0	....	50.0	3.84
Fresh range	24	155	17.0	25.0	....	42.0	3.68

*Greenish-white diarrhea, small in quantity, which is characteristic of ailing birds in cages, probably because this condition can be so readily observed in case of individually caged layers whereas the same condition may prevail unobservable among the floor birds.

In 1931 the various groups of pullets were placed in individual laying cages, where all groups were fed and managed the same. Contrary to the previous test, the fly-screen birds made a more favorable showing in comparison with the other groups, insofar as production and total mortality were concerned. Was this because they were transferred directly to laying batteries late in the fall when flies were scarce and thus were less exposed tc infections from flies and other sources? The best production was from the pullets grown on fresh range and by far the poorest production was from the pullets raised on contaminated range. Not only was the number of eggs recorded for this group decidedly lower, but 20 per cent of these eggs was unmarketable because of weak or soft shells. These eggs were so poorly shelled that they passed through the wire bottoms of the cages when laid; whereas there was but one per cent of such eggs from the other groups. This might suggest that poor shell texture in this instance was due to a pathological condition of the shell-forming portion of the oviduct and might be attributed to exposure to the contaminated range. Again, as during the previous year, range paralysis was most prevalent among the pullets raised on fresh range. In this test the birds from contaminated range weighed the most. The weight of the birds in this instance did not seem to indicate superiority over the other groups which weighed less.

The earlier tests in 1930 and 1931 (Tables 3, 4, and 5) were started with pullets subjected to the different managements when 10 and 7 weeks old. The following tests in 1932 and 1933 (Tables 6, 7, and 8) were started with chicks which were subjected to the different managements when 2 weeks old. This difference in the age of exposure, particularly in the case of contaminated range, proved an important point, as will be observed later in connection with the behavior and performance of the different groups of pullets as layers. Except for starting with chicks instead of pullets, the 1932 test was a repetition of the two previous tests.

TABLE 6.—Confinement Versus Range for Growth of Chicks and Pullets Wooster, Ohio

Management	Year	Chicks	Date hatched	Duration of test	Mortality	
					Paralysis	Total
		No.		*Weeks*	*Per cent*	*Per cent*
Sun porch	1932	220	April 26	18	4	18
	1933	350	April 4	21	4	14
Sun porch, fly-screened	1932	220	April 26	18	8	17
Sun porch, electric brooder	1933	350	April 4	21	3	19
Contaminated range	1932	220	April 26	18	4	24
	1933	350	April 4	21	4	17
Fresh range	1932	220	April 26	18	5	12
	1933	350	April 4	21	4	12
Battery brooded and raised	1933	350	April 4	21	3	14

The mortality of the chicks and growing pullets on fresh range in 1932 was less than any of the other groups and but half that of the pullets raised on contaminated range. The loss from paralysis was practically the same in all groups, except for the fly-screened pullets, for which the mortality from

paralysis was twice that of the other groups. All groups of pullets in 1932 were tested as layers, both in individual laying batteries and in the laying house, where all received the same feed and management.

TABLE 7.—Confinement Versus Range for Layers in Individual Cages and in Laying House, September 29, 1932—June 21, 1933
(38 weeks)

Management	Pullets	Eggs per bird	Mortality					Average weight per bird
			Paralysis	GWD*	Colds, roup, pox	Pick-outs	Total	
	No.	*No.*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Pounds*
Wire sun porch								
Caged	24	113	33	8	....	....	45	3.81
Housed	40	107	28	....	....	7	70	3.58
Fly-screened sun porch								
Caged	24	107	37	33	....	....	74	3.72
Housed	40	132	25	....	3	12	60	3.64
Contaminated range								
Caged	24	121	13	21	....	....	42	3.72
Housed	34	136	41	....	....	....	73	3.71
Fresh range								
Caged	24	120	21	17	....	....	42	3.92
Housed	39	123	35	....	....	....	70	3.64

*Greenish-white diarrhea data obtainable only from caged layers.

The outstanding feature of this test was the high rate of paralysis among all groups regardless of the management of the pullets. Incidentally, these pullets were hatched from purchased eggs secured from breeding flocks supposedly free of paralysis, as a check upon the Station's breeders previously used. Does this high percentage of loss from paralysis mean that the imported eggs were from flocks comparatively free of paralysis and consequently non-resistant to paralysis with the result that when the chicks and growing pullets were exposed to the infection on the Station's premises it proved all the more disastrous?

Although the total mortality was heavy in all the groups, it was decidedly less among the caged birds, with the exception of the fly-screened group, than among those that were in the laying house.

The fourth test in 1933 was also started with chicks and included two additional managements of the chicks and pullets. The fly-screen group was discontinued, Tables 6 and 8. In case of the sun porch - electric brooder group, the chicks were brooded under an electric hover; whereas the other groups were brooded by means of gas-heated coal stove brooders. This group was confined to a wire sun porch near the contaminated range group until 8 weeks of age, when they were turned out on the contaminated range along with the other group of pullets which had been on this range since they were 2 weeks old. This was an important feature of the test, as will be seen later when the two groups are compared as layers.

In the 1933 test with chicks and growing pullets (Table 6), the lowest mortality was in the fresh range group. The loss from range paralysis was practically the same among all the groups, irrespective of the mode of management. The weights of birds were not secured because of reduced budget for labor.

TABLE 8.—Confinement Versus Range for Layers September 1, 1933—February 28, 1934

(26 weeks)

Test	Pullets	Caged or housed	Eggs per bird	Mortality			
				Paralysis	GWD*	Colds, roup, pox	Total
	No.		*No.*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Sun porch	24	Caged	62	....	4.2	....	12.5
	40	Housed	48	4.0	....	17.0	45.0
Sun porch - electric brooder	24	Caged	62	16.7	12.5	8.3	41.5
	40	Housed	50	11.0	....	18.0	44.0
Contaminated range	24	Caged	61	8.3	16.7	....	37.5
	40	Housed	52	7.0	....	....	26.0
Fresh range	24	Caged	71	4.2	....	....	20.8
	40	Housed	79	7.0	....	3.0	30.0
Battery brooded and raised	24	Caged	62	4.2	....	....	12.5
	40	Housed	38	6.0	....	25.0	56.0

*Greenish-white diarrhea data obtainable only from caged layers.

While this test with the pullets as layers is incomplete, the results to date are of special interest. The best egg production has been secured from both the caged and housed groups of pullets raised on fresh range. But when it comes to mortality, this and preceding tests offer a fertile field for speculation regarding the theory of acquired resistance to certain diseases and infections—namely, that certain diseases or exposure to certain infections appears to give protection of the subject against certain other diseases or infections. For example, in medical science it has been reported that certain children's diseases tend to make children more resistant or immune to certain other diseases. The children who have had their round of children's diseases are said to be "experienced" as to the development of their resistance or immunity to certain other diseases. We suspect this may also apply to young chicks; for example, it is a pretty well established fact that pullets raised in batteries or confined so as not to be exposed to various diseases and infections go "all to pieces" when later subjected to such exposure. Going back to Table 3, it will be observed that the chicks during the first 2 years' tests were all raised in battery brooders 5 to 8 weeks before the pullets were subjected to the different managements, so that the pullets were 7 to 10 weeks old before actual exposure to the contaminated range. That these pullets were adversely affected by the late exposure to the range is indicated in Tables 4 and 5 by the heavy losses from colds, roup, and pox in 1930 and, in the following year, by the heavy mortality and low egg production (20 per cent of the eggs produced were unmarketable due to weak shells). In the next year's test, Table 6, the chicks were started in the colony houses and the one group subjected to the contaminated soil regularly after 2 weeks. Although all groups of layers did poorly in this test (Table 7), the pullets raised on contaminated soil did as well as the others.

In 1933 the chicks were also started in the colony houses and were subjected to the different managements after 2 weeks of age, with the exception of the sun porch - electric brooder group, which was confined to the sun porch until 8 weeks of age, when they were given access to the same contaminated range as had been used by the other group since two weeks of age, Table 6.

No ill effect was observed with the growing pullets while on range. Since the weather was hot and dry, it was supposed that no ill effect might result. However, the reaction of these pullets as layers (Table 8) suggests that they were non-resistant to the contaminated range and suffered from the exposure to it after 8 weeks old, if the heavy losses from paralysis, colds, roup, and pox may be taken as an index. In this connection it seems that the inexperiencd pullets from the sun porch and battery groups remained so when continued in the laying batteries but suffered in the laying house, as indicated by their lack of resistance to colds, roup, and pox. In contrast to this there was no loss from these complications among the pullets which were subjected to contaminated range after 2 weeks of age.

TABLE 9.—Summary of Behavior and Performance of Confined Versus Contaminated-range and Fresh-range Pullets as Layers

Management	Year	Eggs per bird	Mortality: Paralysis	Mortality: Colds, roup, pox	Mortality: Total	Average weight per bird
		No.	*Per cent*	*Per cent*	*Per cent*	*Pounds*
Sun porch	1930	151	5.3	13.0	42.0	3.33
	1931	132	4.0	....	33.0	3.74
	1932	113*	33.0	....	45.0	3.81
		107†	28.0	....	70.0	3.58
	1933	62*	....	....	12.5	....
		48†	4.0	17.0	45.0	....
	Average	102	12.4	5.0	41.2	3.61
Contaminated range	1930	131	8.8	41.0	68.0	3.23
	1931	102	8.0	....	50.0	3.84
	1932	121*	13.0	....	42.0	3.72
		136†	41.0	....	73.0	3.71
	1933	61*	8.3	....	37.5	....
		52†	7.0	....	26.0	....
	Average	100	14.3	7.0	49.4	3.62
Fresh range	1930	142	16.2	13.0	50.0	3.50
	1931	155	17.0	....	42.0	3.68
	1932	120*	21.0	....	42.0	3.92
		123†	35.0	....	70.0	3.64
	1933	71*	4.2	....	20.8	....
		79†	7.0	3.0	30.0	....
	Average	114	16.7	2.6	42.4	3.69

*Caged.
†In laying house.

It should be emphasized that these interpretations of the data presented are speculations rather than conclusions. However, we seem to be constantly securing evidence and experiences which tend to substantiate such speculations and perhaps, in due time, may develop into definite conclusions.

The points emphasized by the data as a whole are: First, that according to these tests, it would seem to be extremely hazardous to brood chicks and grow pullets in confinement or in batteries if they are to be exposed later to disease or parasite contaminated soil or similar infections from other sources. Second, that if chicks or pullets are to be exposed to contaminated soil or premises, the exposure should be as soon as possible after they are 2 weeks of

age, so as to give them the opportunity to acquire resistance to the infections at an early age; or, to put it differently, if chicks are brooded and the pullets are grown in confinement, they should be carefully guarded against the hazards of contaminated soil and the like by continued confinement or be transferred to a range known to be free of disease contamination. Third, that range paralysis persisted much the same irrespective of the different managements tested. In fact, there was a slightly higher percentage of paralysis among the layers raised on fresh range and in confinement than those raised on contaminated soil, Table 9.

These 4 year's results and experiences under varying conditions have demonstrated that the behavior and performance of pullet layers are definitely influenced by their management as chicks and growing pullets. However, management in itself had its limitations and all the managements tested failed to prevent or control some of the most serious causes of mortality, such as paralysis and the cholera-like diseases. For their prevention and control, we believe that special breeding, selection, feeding, and management for the development of birds resistant or immune to such complications offer the best promise for the final solution of the problem.

LIMESTONE AND OTHER FACTORS IN PASTURE IMPROVEMENT

S. C. HARTMAN AND D. R. DODD

Luxuriant pasture continues to grow on certain plots of a series laid out in 1915 on the Southeastern Experiment Farm at Carpenter, Ohio; treatments were discontinued on these plots in 1927. The series was laid out on a hill top and on a very thin, sour, Meigs silt loam soil. The land had never been plowed but had been in permanent pasture for many years. At the time the plots were laid out, the pasture on most of the area was similar to that which still exists on the untreated plots. On these plots the predominating vegetation is poverty grass and small weeds. Approximately 20 per cent of the area is bare of all vegetation. There is a sprinkle of small, puny blue-grass plants but no clover. Treatments applied to the various plots are given in Table 1.

TABLE 1.—Fertilizer and Limestone Applications of Plots in Pasture 5, Southeastern Experiment Farm

Plot	Material applied	Ratios or analyses equivalents	Amount applied, in terms of equivalent analyses		
			Each* application	Average annual†	Total
No.			*Lb.*	*Lb.*	*Lb.*
1	Check, no treatment	... .	0	0	0
2	100 lb. 16% superphosphate	0–20–0	80	25	480
3	200 lb. 16% superphosphate 50 lb. muriate of potash	0–10–8	320	100	1,920
4	200 lb. 16% superphosphate 50 lb. muriate of potash 100 lb. nitrate of soda	5–10–8	320	100	1,920
5	Check, no treatment	....	....	....	....
6	4000 lb. limestone	....	....	1,250	24,000
7	5 tons stall manure 200 lb. 16% superphosphate	10– 4–10 0–20–0	550‡ 160	175 50	3,300 1,000
8	5 tons yard manure	10– 5–10	400	125	2,400
9§	4000 lb. limestone	....	....	1,250	24,000

*Applications were made on alternate years from 1915 to 1927, inclusive, except 1925.
†Average annual application equivalent from 1915 to 1933, 19 years.
‡The treatment on Plot 7 is equivalent to a 10-10-10 at the rate of 550 pounds at each application, 175 pounds annually, or 3300 pounds for the 19 years.
§Plot 9 is a cross plot extending across all the other plots.

Recent soil tests indicate that the unlimed plots range in reaction from pH 5 to nearly 6 for the top 4½ inches and from less than 5 to 5.5 for the next 4½ inches in depth. The top soil on some of these plots may have the benefit of wash from the limed plots. The limed plots range from pH 6.8 to pH 7.5 for the surface 4½ inches, with the next 4½ inches showing from pH 6.25 to pH 6.75. The limestone was applied with a lime spreader. The commercial

fertilizer was applied with a disc drill, except that applied to the manure plot for which the fertilizer was mixed with the manure before being spread. The fertilizer applications were usually made during the summer, and no attempt was made to incorporate them into the soil. Blue-grass seed was sown on all plots at the rate of 12 pounds per acre in the late summer of 1919.

Management.—The pasture was grazed from about May 10 until bad weather set in in the fall or early winter. Grazing, although heavy at times, was not extremely severe. The pastures were grazed with sheep alone until 1930, after which cattle were turned on at times with the sheep. The pastures were usually clipped once or twice during the summer in order to control weeds.

Results.—Notes have been kept from year to year on the character and nature of the vegetation. The plots receiving manure were the first to respond to the treatment. The response began almost immediately, and by 1918 the plots were covered with a dense mat of blue grass. The reinforced stall-manure plot has continually shown up better than the yard manure alone. The development of blue grass on the manured plots apparently reached a maximum soon after 1925. The sheep seemed to graze less on these plots because of the rank growth. After the plots were grazed by cattle in 1930, the sheep grazed these plots more closely and white Dutch clover came in.

By 1918 the commercial fertilizer plots were showing some improvement, particularly the one receiving a complete fertilizer, but none was so good as the manured plots. In 1923 more clover appeared on the commercial fertilizer plots and further improvement was evident, but the total improvement was not great and the division line between them and the untreated plot was not sharply defined. Even at the present time the plots receiving commercial fertilizer alone are little better than the untreated plots. Where limestone was also used the fertilizers have been much more effective.

The effect of the limestone alone showed up more slowly but in recent years has become very marked and promises to continue longer than that of the other treatments. In 1918 the limestone plot showed a little improvement but was inferior to any of the commercial fertilizer plots and decidedly inferior to the manure plots. By 1923 the effect of the limestone was more pronounced. Where limestone alone has been applied, the pasture was about equal to what it was where phosphate alone was applied; but, where limestone was applied in addition to commercial fertilizer, the difference in appearance caused by the lime was sufficient to be seen readily from a half mile away. Clover was abundant and the plots were closely grazed. The blue grass on the reinforced manure plots was luxuriant and of a darker green color where limestone also was applied. A like difference was evident on that portion of the yard-manure plot which received limestone.

This superior effectiveness of limestone over other single treatments has continued to increase from year to year until it has outstripped all others, including the manure plots. This may be observed in Table 2, which shows the average condition of all the plots for the two seasons 1932 and 1933.

SUMMARY

An experiment to determine the effectiveness of limestone and various fertilizer combinations in the improvement of permanent pasture was started in 1915 at the Southeastern Experiment Farm, Carpenter, Ohio. The soil, a Meigs silt loam, was of very low productivity and high lime requirement. All treatments were discontinued in 1927.

TABLE 2.—Flora Estimates of Plots in Pasture 5, Southeastern Experiment Farm, 1932 and 1933

(Average or mean for the two seasons, 1932 and 1933)

Plot number ☞	1	2	3	4	5	6	7	8
Character of vegetation and growth	Check	100 lb. Superphosphate per acre	200 lb. Superphosphate 50 lb. Muriate of potash per acre	200 lb. Superphosphate 50 lb. Muriate of potash 100 lb. Nitrate of soda	Check	2 tons limestone per acre	Superphosphate and reinforced stall manure, 40 lb. per ton. 5 tons per acre	Open-yard manure untreated 5 tons per acre
Limestone at the rate of 2 tons per acre in addition to the treatments indicated								
Clover, Pct.	27	17	2	12	21	52	18	20
Tame grasses, Pct.	50	68	86	77	53	38	71	62
Wild grasses, Pct.	7	3	4	4	13	2	2	8
Weeds, Pct.	10	10	7	6	7	5	6	6
Bare, Pct.	6	2	1	1	6	3	3	4
Growth*	F	V—	V	V	F	F	V	V—
No basic treatment of limestone								
Clover, Pct.	0	2	2	6	1	26	12	11
Tame grasses, Pct.	16	25	21	16	10	60	43	25
Wild grasses, Pct.	52	39	48	52	45	2	12	26
Weeds, Pct.	19	25	17	18	33	9	23	25
Bare, Pct.	13	9	12	8	11	3	10	13
Growth*	S	S—	S—	S—	S	V—	F	F

*Growth: (V) Vigorous, (F) Fair, or (S) Scant.

Under these conditions it was found that limestone was the most effective of all the materials tried in bringing about improvement. Manure and superphosphate together produced immediate and very marked results. The addition of limestone gave further and more lasting improvement; whereas other treatments were of doubtful value unless accompanied by limestone.

Limestone alone was slow in comparison with manure and other fertilizers in showing results, but in recent years it has outstripped all other treatments, and its effectiveness is as pronounced 6 years after the last treatment as at any previous time.

Lime, manure, and superphosphate were found to produce quick and long continued results. Lime and commercial fertilizers were slower to show results but in recent years have been equally as effective and enduring as where manure was included.

RESPONSES FROM THE USE OF NITROGEN FERTILIZER ON RED RASPBERRIES

J. S. SHOEMAKER

The use of nitrogen fertilizer has caused marked, beneficial responses when applied to red raspberries in an experiment at Wooster. The effects have been beneficial on the vigor of canes and on the yield and quality of berries. The full measure of value of the fertilizer applied does not appear in the current year because the canes are grown in one year and the berries produced the next. Hence, it is proper to consider (a) the results for successive years and (b) the use of fertilizer in relation to the subsequent pruning and training treatments.

THE PLOTS AND TREATMENT

The plants were set in the spring of 1929; the planting distance was 2 feet apart in the row and 8 feet between rows. The same number of plants was set in each row and all grew. The rows were 84 feet long. Prior to setting the red raspberry plants the land had been occupied by strawberries for 3 years, followed by a cover crop for a year and pumpkins for a year.

Application of the nitrogen fertilizer was made first in 1931—the third year of the raspberry planting—and annually thereafter, at the rate of 250 pounds of sulfate of ammonia per acre. Records of cane growth and yield have been kept since the third year (1931). When the fertilizer was first applied, little difference was apparent in the stand of plants in five of the six rows which form the basis of this discussion. Row 1, an unfertilized row, is located alongside a road, and this fact has adversely affected the behavior of the plants in it. However, although the data from Row 1 have increased the difference in favor of the fertilized rows, the general trend of the results has not been changed by including this row with the other checks (Rows 3 and 5) in the report.

Rows 2, 4, and 6 have been fertilized annually in early spring. The fertilizer has been applied within 2 feet of the sides of each treated row, and some has been placed in the rows between the canes but not in direct contact with them.

The writer is well aware of the fact that much more improvement over the arrangement of plots could be made than has prevailed in this experiment. However, the differences in results between the unfertilized and fertilized rows have been so striking that their significance is unquestionable generally.

EFFECT ON VIGOR[1]

The fertilizer applications have caused beneficial effects on vigor from the standpoint of number of canes, diameter of cane, and height of cane. Also, although not shown directly by data, the foliage on the fertilized rows was so much darker green that simple observation of this factor has been sufficient to distinguish between the fertilized and unfertilized rows.

Number of canes.—In 1931, the three unfertilized rows (Rows 1, 3, and 5) formed 103, 159, and 127 canes, respectively, or a total of 389 canes; the three fertilized rows (Rows 2, 4, and 6) produced 211, 211, and 318 canes, respectively, or a total of 740 canes. The corresponding rows with canes formed in 1932 for fruiting in 1933 produced the following numbers of canes: Unfertilized—120, 191, and 172 canes, respectively, or a total of 483 canes; fertilized—204, 371, and 353 canes, or a total of 928 canes. The number of canes formed in 1933 for fruiting in 1934 was 141, 232, and 176 canes, or a total of 549 canes for the three check rows, and 332, 422, and 463 canes, or a total of 1217 canes, for the three rows fertilized with nitrogen. Thus, in 1931, 351 more canes, in 1932, 545 more canes, and in 1933, 668 more canes per 252 feet of row (3 rows, each 84 feet long) were formed for fruiting the succeeding year, respectively. Undoubtedly, unless other factors intervene, the use of a nitrogen fertilizer promotes a significant increase in number of canes.

Cane diameter.—The total of the diameters of the canes in the fertilized rows proved to be roughly twice as great as that of the unfertilized checks. It is noteworthy that an increase in number of canes per row has not been accompanied by a decrease in their diameter; in fact, a slight increase would become evident, more clearly than the data show, as a result of pruning practice. Because the treated rows contain a much greater number of canes, the grower will likely eliminate more slender canes in pruning the fertilized plants. More canes of the larger classes of diameter occurred in the fertilized than in the check rows.

Height of cane.—Considering the canes which formed in 1933 for fruiting in 1934, the average height of cane occurs within the 56-60 inch class for both the unfertilized and fertilized plants. A total of 165 unfertilized, or 30.0 per cent, in contrast to 458 fertilized canes, or 37.7 per cent, was more than 5 feet in height. The fertilizer applications resulted (a) in a greater total number of canes and (b) in a greater number and proportion of canes 5 feet or more in height. By removing the shortest canes in pruning, as should be done, the average height of canes becomes greater in the fertilized than in the check rows.

EFFECT ON YIELD

In the fourth year of the planting (1932)—a year after the first application of fertilizer—the three unfertilized rows produced 49.2, 101.9, and 85.9 pints, respectively, or a total of 237.0 pints of berries. The adjacent fertilized rows produced 113.2, 121.8, and 120.5 pints, respectively, or a total of 355.5

[1]For brevity, only a part of the data is presented.

TABLE 1.—Comparison of the Diameter of Fertilized and Unfertilized Canes of the Cuthbert Red Raspberry (Measurements 2 Inches Above Ground)

Diameter In.	Unfertilized rows					Fertilized rows				
	Row 1 No. canes	Row 3 No. canes	Row 5 No. canes	Total No. canes	Total Pct.	Row 2 No. canes	Row 4 No. canes	Row 6 No. canes	Total No. canes	Total Pct.
Canes which grew in 1931 and fruited in 1932										
6/32— 8/32	6	4	8	18	4.6	3	5	15	23	3.1
9/32—10/32	12	14	17	43	11 0	22	10	36	68	9.2
11/32—12/32	17	30	19	66	16.9	55	19	58	132	17.8
13/32—14/32	28	32	14	74	19.0	41	49	64	154	20.8
15/32—16/32	17	39	23	79	20.3	48	56	77	181	24.4
17/32—18/32	15	19	18	52	13.4	21	37	37	95	12.8
19/32—20/32	6	14	7	27	6.9	12	24	21	57	7.7
21/32 up	2	7	21	32	8.2	9	11	10	30	4.0
Total	103	159	127	389	....	211	211	318	740	....
Canes which grew in 1932 and fruited in 1933										
6/32— 8/32	39	41	41	121	25.0	13	103	83	199	21.4
9/32—10/32	28	44	47	119	24.6	68	122	91	271	29.2
11/32—12/32	32	62	43	137	28.4	85	101	120	306	32.9
13/32—14/32	14	39	27	80	16.6	35	44	55	134	14.4
15/32—16/32	6	4	9	19	3.9	2	0	11	13	1.4
17/32—18/32	1	1	1	3	0.6	1	1	3	5	0.5
19/32—20/32	0	0	4	4	0.8	0	0	0	0	0
Total	120	191	172	483	....	204	371	353	928	....

TABLE 2.—Comparison of the Height of Fertilized and Unfertilized Canes of the Cuthbert Red Raspberry

Height In.	Unfertilized rows					Fertilized rows				
	Row 1 No. canes	Row 3 No. canes	Row 5 No. canes	Total No. canes	Total Pct.	Row 2 No. canes	Row 4 No. canes	Row 6 No. canes	Total No. canes	Total Pct.
Canes formed in 1933 for fruiting in 1934										
25-30	15	10	13	38	6.9	16	22	18	56	4.6
31-35	11	14	11	36	6.6	13	14	16	43	3.5
36-40	14	13	27	54	9.8	22	30	46	98	8.1
41-45	10	16	13	39	7.1	23	23	36	82	6.7
46-50	19	35	31	85	15.5	54	51	64	169	13.9
51-55	22	21	15	58	10.6	41	42	56	139	11.4
56-60	25	35	14	74	13.5	53	49	70	172	14.1
61-65	9	19	24	52	9.5	36	48	61	145	11.9
66-70	8	35	21	64	11.6	39	65	55	159	13.1
71-75	5	21	5	31	5.6	19	39	33	91	7.5
76-80	2	10	2	14	2.6	13	30	7	50	4.1
81-85	1	3	0	4	0.7	3	7	1	11	0.9
86-90	0	0	0	0	....	0	2	0	2	0.2
Total	141	232	176	549	....	332	422	463	1217	....

pints. Thus, each fertilized row yielded more than each unfertilized row, and the total increase for the three fertilized rows was 118.5 pints for 252 feet of row, which is a decidedly appreciable amount.

In the fifth year of the planting (1933), the three unfertilized rows produced 49.4, 90.4, and 73.4 pints, respectively, or a total of 213.2 pints; whereas, the fertilized rows produced 98.0, 115.0, and 102.4 pints, respectively, or a total of 315.4 pints. Thus, each fertilized row again produced more berries; the total increase for the three fertilized rows was 102.2 pints.

TABLE 3.—Comparison of the Yield of Fertilized and Unfertilized Cuthbert Red Raspberry Plants

Year	Unfertilized rows				Fertilized rows			
	Row 1	Row 3	Row 5	Total	Row 2	Row 4	Row 6	Total
	Pints	*Pints*	*Pints*	*Pints*	*Pints*	*Pints*	*Pints*	*Pints*
1932	49.2	101.9	85.9	237.0	113.2	121.8	120.5	355.5
1933	49.4	90.4	73.4	213.2	98.0	115.0	102.4	315.4
Total	.....	.....	.....	450.2	.....	.....	.....	670.9

The total yield from the fertilized rows for the fourth and fifth years collectively exceeded that from the checks by 220.7 pints for 252 feet of row.

PRACTICAL CONSIDERATIONS

The data in this work should be regarded as indicating a trend which may be expected to apply generally, rather than as figures which can be duplicated exactly in other plantings.

An application of nitrogen fertilizer annually (250 pounds per acre[2] of sulfate of ammonia or a corresponding amount of other nitrogen fertilizer such as nitrate of soda or calcium cyanamid) should result in an increase in yield in most Ohio plantings of red raspberries, unless other factors intervene, such as disease infection, poor drainage, and a soil already of high fertility.

The chief ways in which nitrogen fertilizer results in increased yield are probably through an increase in the total number of canes and in the number and proportion of tall canes of large diameter.

In many Ohio plantings the canes have not averaged more than 3-3½ feet in height; the predominance of comparatively short canes and of a small number of tall canes has been an important factor precluding a high yield in these plantings. This situation has also precluded the leaving, in pruning, of canes as tall as is best for a high yield. On the other hand, in some plantings tall canes of large diameter have been grown, but they have been shortened so severely in pruning that the yield has been greatly reduced and the dense shoot growth which has resulted has made harvesting more difficult and has encouraged infection by certain diseases.

[2]Perhaps a higher rate of application than has been mentioned may be advisable in a number of cases, as the data indicate that red raspberries are "heavy nitrogen feeders". The differences in nitrogen fertilizers, with respect to rate at which nitrogen becomes available, cost of material, effect of soil reaction, nitrogen content, etc., should be given consideration by growers.

It is suggested that tall red raspberry canes be grown and that some means of support be provided so that a suitable height of cane can be maintained properly after pruning. In the planting at Wooster a wire extends along each side of the rows at a height of about 4½ feet and the canes are pruned so that about 6 inches of cane protrude above the wire.

It may be unwise to leave the canes taller than 5-5½ feet after the dormant pruning, especially if they are not supported properly. In windy weather, for example, much injury may be done to the succulent fruiting

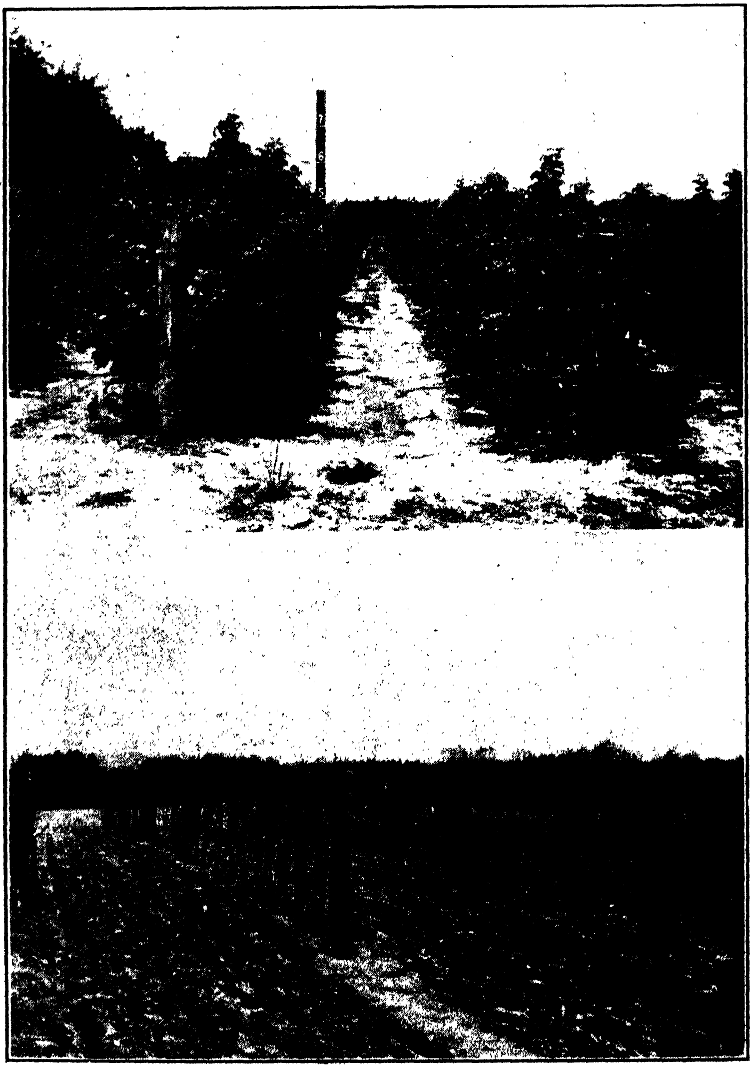


Fig. 1.—Above—Nitrogen fertilizer caused vigorous cane growth. Below—The canes have been headed while dormant to a height of 5-5½ feet, the slender canes in the row have been removed, and the rows of plants have been kept narrow.

shoots. The berries near the ends of the canes are comparatively small; however, some growers have purposely left the canes longer than usual because the berries produced near the ends of the canes are the earliest and for this reason have commanded a good price.

Although a large number of canes per given area is highly desirable, the canes in the row should not be too crowded nor should the rows be too wide. Spacing the canes in pruning so that they are not closer than 6-8 inches apart in the row is a general recommendation, but it is not always best to adhere strictly to this rule. Short, slender canes should be removed rather than large ones. In pruning red raspberries at Wooster canes large enough to reach above the wires have seldom been removed, except to keep the rows relatively narrow. The wider the rows the more berries that will probably be produced; but, when the rows become too wide, proper tillage, picking, and other operations are interfered with.

The fact that high yields of Latham (which is the leading red raspberry in Ohio) have been reported from certain shipping sections of the Midwest, where the plants are grown in hills, are tied to stakes 5-5½ feet high, and this height of cane maintained, indicates (a) the importance of tall canes in this variety and (b) that the vigorous canes have not produced soft berries[8].

The following brief suggestions are made as a result of the experiment reported here—

1. Nitrogen fertilizer should be applied to provide:
   (a) A suitable number of canes for a high yield.
   (b) A high proportion of tall canes of large diameter.
   (c) Dark green leaves which are associated with a high rate of photosynthetic activity.
2. In pruning:
   (a) Summer topping of reds should be avoided.
   (b) The dormant pruning should be as light as is compatible with suitable training, freedom from damage in cultivation, ease of harvesting, and avoidance of undesirable small berries near the ends of the canes and in accordance with the fertility, moisture supply, and other factors that influence the growth status of the plants.
   (c) The rows of plants should be kept comparatively narrow.
   (d) Only short, slender canes should usually be thinned out in the rows.
   (e) The canes should be encouraged to grow tall enough so that a height of 5-5½ feet can be maintained after pruning and such canes should be supported by wires in the row system and by stakes in the hill system.
3. Other practices:
   Humus should be supplied, moisture should be conserved, the possibilities of irrigation should be considered, other elements besides nitrogen should not be lacking in the soil, drainage should be good, and practices in general should be such as will promote vigorous, healthy cane growth. Growth should be encouraged early rather than late in the season. A high yield in a given red raspberry variety is largely dependent on a large amount per area of the most highly productive kind of fruiting wood.

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[8]With respect to this point, experiments with strawberries in Ohio have indicated that moisture supply affects firmness of berries much more than does the use of nitrogen fertilizer.

THE INFLUENCE OF CERTAIN SPRAY MATERIALS, HERBICIDES, AND OTHER COMPOUNDS ON THE DESICCATION OF PLANT TISSUE

H. A. RUNNELS AND J. D. WILSON

Observations made during the summer of 1930 which indicated that bordeaux mixture increased drouth injury to plants (1) suggested that experiments be started in an effort to determine the influence of bordeaux mixture on the water relations of plants growing in soil of a low moisture content. It has since been found that bordeaux mixture increases the transpiration rate from three to ten times during the night period. The fact that this acceleration is largely confined to the period during which the stomata are closed indicates that the increase is chiefly concerned with cuticular transpiration (2). It was shown in a previous paper (3) that various spray materials affected the rate of water loss from growing plants and cut shoots in a similar manner.

Olive (4) has suggested that the effectiveness of iron sulfate in killing the tops of plants is at least partly due to its ability to desiccate leaf tissue. Aslander (5) is of the opinion that this material kills in the act of leaf penetration and that materials of high acidity, like sulfuric acid, kill by virtue of their high hydrogen-ion concentration. Such chemicals as sodium chlorate kill plant tissue because of their oxidizing action when in contact with organic matter (6). The herbicidal action of a wide variety of compounds has been tested by such workers as Offord (6), Regan (7), and Thompson and Robbins (8). Various investigations have also been made on the effect of various compounds on the transpiration rate of plants when added to the soil or culture solution. Bouyoucos (9) found that, in general, transpiration increased with a decrease in the density of the nutrient solution and that non-nutrient salts diminished the transpiration rate more than the plant food salts.

The possibility that some of the injuries resulting from the use of spray compounds (particularly bordeaux mixture) were brought about through their effect on the water relations of plants led, in the work here reported, to a study of the effects of various fungicides, insecticides, and herbicides on the rate of desiccation of plant tissues treated with them. The procedure usually followed involved cutting a number of shoots or leaves from plants growing in the field or greenhouse and dividing these into the desired number of lots, each of equal weight, in as short a time as possible to avoid their wilting before they

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1. Wilson, J. D. and H. A. Runnels. 1931. Bordeaux mixture as a factor increasing drouth injury. Phytopath. 21: 729-738.
2. Wilson, J. D. and H. A. Runnels. 1933. Some effects of bordeaux mixture on transpiration. Ohio Agr. Exp. Sta. Bimo. Bull. 18: 147-151.
3. Wilson, J. D. and H. A. Runnels. 1934. Influence of bordeaux mixture and oil emulsion on water requirement. Ohio Agr. Exp. Sta. Bimo. Bull. 19: 21-28.
4. Olive, E. W. 1909. The killing of mustard and other noxious weeds in grainfields by the use of iron sulphate. S. D. Agr. Exp. Sta. Bull. 112, 485-498.
5. Aslander, Alfred. 1927. Sulphuric acid as a weed spray. Jour. Agr. Res. 34: 1065-1091.
6. Offord, H. R. 1931. The chemical eradication of Ribes. U. S. Dept. Agr. Tech. Bull. 240, 1-24.
7. Regan, W. S. 1919. The destruction of Ribes by chemical means. Amer. Plant Pest Comm. Bull. 4, 1-12.
8. Thompson, N. F. and W. W. Robbins. 1926. Methods of eradicating the common barberry (*Berberis vulgaris* L.) U. S. Dept. Agr. Bull. 1451, 1-45.
9. Bouyoucos, G. J. 1930. Transpiration of wheat seedlings as affected by soils, by solutions of different densities, and by various chemical compounds. Jour. Amer. Soc. Agron. 3: 130-191.

could be treated. They were then dipped in the previously prepared solutions and immediately hung up to dry, free from contact with each other, on the edge of a rotating table. As soon as the material on the surface of the leaves had become dry the first weighing was made. In obtaining most of the results given below three weighings were made at hourly intervals, and then the shoots were discarded.

A rather detailed series of experiments on the effect of bordeaux mixture, used in various formulae, on the rate of desiccation has been carried out. A 4-6-50 bordeaux mixture increased the rate of drying of shoots of a number of plants over that of similar water-treated checks as follows: Coleus, 133 per cent; bean, 68 per cent; tomato, 64 per cent; muskmelon, 36 per cent; watermelon, 22 per cent; squash, 20 per cent; potato, 18 per cent; and cabbage, 14 per cent.

These results indicate that thin, tender leaves, like those of Coleus and bean, are dried out more rapidly than the more fleshy leaves of potato and cabbage. In another experiment a 3-4½-50 bordeaux mixture, an oil emulsion (Volck concentrate, 1-100), and a mixture of these two in equal parts increased the rate of drying of tomato shoots in comparison with a water-treated check +50, —36, and +6 per cent, respectively. These results are in agreement with those reported earlier by the authors (3). In this connection, another experiment might be discussed in which the effect of these three spray materials on the survival of seedlings of tomato and cucumber at the time they were transplanted was studied. The seedlings were treated with these materials as they were removed from the flat. They were then transplanted into pots containing a soil of medium moisture content and allowed to stand for 24 hours before they were watered. At the end of one week 97 and 73 per cent of the water-treated tomato and cucumber seedlings, respectively, were alive. Of those treated with bordeaux mixture only 20 and 7 per cent, respectively, survived. Those treated with the oil emulsion did nearly as well as the water-treated checks with a survival of 95 and 70 per cent. A mixture of the two sprays was not as severe in its action as the bordeaux alone and 82 and 58 per cent lived. These results indicate that the practice of spraying seedlings with bordeaux mixture just before or after transplanting is detrimental to the survival of the transplants.

When Coleus shoots were treated with a 2-3-50, 4-6-50, and a 6-9-50 bordeaux mixture, the increases in rate of drying over water-treated checks were 76, 112, and 161 per cent, respectively. The increases resulting from the use of a 6-0-50 and an 0-9-50 formula were 49 and 27 per cent, respectively. These data indicate that a strong bordeaux mixture increases the rate of desiccation more than a weak one, that a combination of copper sulfate and hydrated lime is more effective than either compound used alone, and that copper sulfate is more effective than hydrated lime in increasing the rate of desiccation.

In the preparation of bordeaux mixture it is commonly recommended that the copper sulfate solution be poured into the lime-water mixture rather than using the reverse procedure. In a study of the relative effect of bordeaux mixture made by these two methods on the rate of desiccation of shoots of cucumber, Coleus, and tomato, the increase over a water-treated check was found to be 70 per cent when the copper was added to the lime and 54 per cent when the lime was added to the copper. This suggests that the first method probably results in the preparation of the better bordeaux mixture, if ability to increase the transpiration rate is a measure of quality. The addition of lamp-

black to bordeaux mixture has been found to make it even more effective in increasing transpiration and was found in these experiments to increase the rate of desiccation approximately 7 per cent when added to various strengths of bordeaux mixture.

In another experiment the effect of variable lime and copper contents used in making bordeaux mixture was considered. The various proportions used and the results obtained are shown in Table 1. The addition of a small amount of lime to the copper sulfate-water mixture increased the rate of desiccation quite noticeably. This was to be expected since one pound of hydrated lime combines with about 4 pounds of copper sulfate. The addition of increasingly large amounts of lime increased the rate of desiccation until the 4-6-50 formula was reached. When the quantity of lime was held constant and the copper sulfate varied, the 4-6-50 formula again gave practically the maximum desiccating effect.

TABLE 1.—Influence of Variations in Copper Sulfate and Lime Content of Bordeaux Mixtures on the Rate of Desiccation of Cut Shoots of Tomato

All values stated as percentage of increase over water-treated checks*

Variable lime		Variable copper	
Treatment	Increase over check	Treatment	Increase over check
	Per cent		*Per cent*
4- 0-50	14	0-6-50	16
4-½-50	30	½-6-50	22
4- 1-50	41	1-6-50	28
4- 2-50	50	2-6-50	52
4- 4-50	67	3-6-50	60
4- 6-50	92	4-6-50	88
4- 8-50	92	6-6-50	90
4-12-50	63		

*The values given in all the following tables were computed on the same basis.

A number of insecticides and spreaders or stickers was added to bordeaux mixture (4-6-50) to determine what, if any, would be the effect on the rate of desiccation of Coleus leaves. The results are shown in Table 2. All of the insecticides decreased the rate of desiccation slightly below that of bordeaux mixture alone; whereas, all of the stickers and spreaders increased the rate slightly.

TABLE 2.—Influence of Various Insecticides and Spreaders (Stickers) on the Rate of Desiccation of Coleus Leaves When Added to a 4-6-50 Bordeaux Mixture

Insecticides (All used at rate of 1 lb. to 50 gal.)		Spreaders (All used at rate of 1 lb. to 50 gal.)	
Treatment	Increase over check	Treatment	Increase over check
	Per cent		*Per cent*
Bordeaux mixture only	50	Bordeaux mixture only	58
Bordeaux + lead arsenate	44	Bordeaux + sulfonated fish oil	64
Bordeaux + calcium arsenate	40	Bordeaux + potash fish-oil soap	75
Bordeaux + Manganar	48	Bordeaux + Bindex	60
Bordeaux + Dutox	36	Bordeaux + Fluxit	64
Bordeaux + Kaolith	40	Bordeaux + Kayso	64
		Bordeaux + aluminum hydrate	69

A series of sulfur sprays was applied to Coleus leaves in a study of the effect of these materials on the rate of desiccation. The increases (percentage) over a water-treated check were as follows: Liquid lime-sulfur, 5; liquid lime-sulfur plus hydrated lime, 24; dry lime-sulfur, 7; colloidal sulfur, 9; Sulfocide, 15; and Sulfuron, 28. It will be noticed that the sulfur-containing sprays were not nearly as effective in increasing the rate of desiccation as was bordeaux mixture.

In a previous paragraph it was shown that Volck concentrate (1-100) decreased the rate of desiccation of cut shoots below that of water-treated checks. The influence of a number of oil sprays was later determined. The decrease in rate of desiccation (percentage) was as follows: Shale-oil kerosene, 4.4; Derrisol, 4.6; Penetrol, 6.7; Verdol, 7.0; sulfonated fish oil, 8.2; Ovex, 10.0; Volck (light), 11.4; Orthol-K, 15.8. These results indicate that oil sprays may be expected to decrease the rate of desiccation, although probably not to as great an extent as they affect the transpiration rate.

In an experiment designed to determine whether the drying property of bordeaux mixture was confined to a combination of copper sulfate and hydrated lime, various other sulfates were substituted for that of copper in a 4-6-50 formula, and shoots of tomato were then dipped in these mixtures and allowed to dry. The results are shown in the left half of Table 3. Ferrous sulfate and manganese sulfate were both found to increase desiccation more than copper sulfate. Zinc sulfate, which is sometimes used in combination with hydrated lime as a summer spray, affected drying considerably less than copper sulfate. In an effort to check the relative effect of the copper ion on desiccation, this and a number of other sulfates were made up in N/10 solution. Fifty grams of Kaolin were added to each liter of solution to insure the adhesion of a little more material to the dipped leaves. The various materials used and the increase in rate of desiccation which they caused in comparison with a water-treated check are shown in the right half of Table 3. None of the other compounds used in this series had as great an effect as copper sulfate.

TABLE 3.—Influence of Various Metal Sulfates in N/10 Solution and in Combination With Hydrated Lime on the Rate of Desiccation of Cut Shoots

Sulfates plus hydrated lime (4-6-50 formula)		Various sulfates used in N/10 solution plus 50 gm. of Kaolin per liter	
Treatment	Increase over check	Treatment	Increase over check
	Per cent		*Per cent*
Ferrous sulfate	82	Kaolin only	7
Manganese sulfate	73	Sodium sulfate	16
Copper sulfate	58	Aluminum sulfate	26
Nickel sulfate	55	Potassium sulfate	30
Ammonium sulfate	40	Ammonium sulfate	36
Zinc sulfate	32	Ferrous sulfate	48
Potassium sulfate	18	Copper sulfate	78

In another experiment a study was made on the relative effect of compounds of copper, other than copper sulfate, on the rate of desiccation. The procedure was identical with that described in the previous paragraph. The results are shown in the left half of Table 4. Only one compound of those included in the experiment had a greater drying effect than copper sulfate—namely, copper chloride. In an experiment similar to the two just described,

the desiccating effect of a variety of sodium compounds was investigated. The results are shown in the right half of Table 4. Sodium chlorate, which has been used as an herbicide, and sodium sulfite increased the rate of drying very noticeably.

TABLE 4.—Influence of Various Copper and Sodium Compounds in N/10 Solution on the Rate of Desiccation of Coleus Leaves

Copper compounds (used in N/10 solution plus 50 gm. of Kaolin per liter)		Sodium compounds (used in N/10 solution plus 50 gm. of Kaolin per liter)	
Treatment	Increase over check	Treatment	Increase over check
	Per cent		*Per cent*
Kaolin only	25	Kaolin only	28
Copper tartrate	30	Sodium borate	32
Copper hydroxide	35	Sodium nitrate	40
Copper sulfate (basic)	52	Sodium sulfate	48
Copper carbonate	55	Sodium fluoride	50
Copper acetate	79	Sodium chloride	53
Copper nitrate	133	Sodium bromide	58
Copper sulfate	160	Sodium chlorate	116
Copper chloride	170	Sodium sulfite	203

Since it has been suggested that the killing effect of various herbicides may be in part due to their desiccating properties, shoots of various plants were dipped in N/10 solutions of a number of compounds sometimes used as weed killers. The results are shown in Table 5. Sodium arsenite, a well known herbicide, caused the greatest increase in the rate of desiccation over that of a water-treated check; ferrous sulfate, another compound commonly used in destroying the top growth of weeds, was least effective.

TABLE 5.—Influence of Compounds Sometimes Used as Herbicides on the Desiccation of Cut Shoots

Used in N/10 solution

Treatment	Calendula	Coleus	Tomato	Average drying effect
	Per cent	*Per cent*	*Per cent*	*Per cent*
Sodium arsenite	160	238	110	169
Sodium chromate	134	170	68	124
Copper sulfate	97	200	76	124
Sodium chlorate + calcium chloride	87	109	66	87
Sodium chlorate	90	121	28	80
Sodium sulfite	68	108	40	72
Ferrous sulfate	77	94	37	69

SUMMARY

A 4-6-50 bordeaux mixture was found to increase the rate of drying of shoots of various species over that of water-treated checks. When this spray material was mixed with an oil emulsion, a compound which decreases the rate of drying, the mixture was found to have little effect when compared with a water-treated check. When these three materials were applied to transplants of cucumber and tomato, it was found that those treated with an oil emulsion survived in practically the same proportion as untreated ones; whereas, the

presence of bordeaux mixture on the seedlings caused the death of most of them. Strong bordeaux mixture increased the rate of desiccation to a greater extent than weaker formulae. Neither hydrated lime nor copper sulfate used alone was as effective as the mixture. Copper sulfate added to lime gave a bordeaux mixture which was more effective in drying plant tissue than was that made by adding the lime to the copper sulfate. When the amounts of copper sulfate and hydrated lime used in making bordeaux mixture were varied, it was found that the 4-6-50 formula closely approached the maximum desiccating effect which could be obtained; that is, greater amounts of lime or copper had little effect. The addition of various spreaders and stickers to bordeaux mixture increased its drying effect slightly. The addition of various insecticides did not do this. Sulfur sprays were found to cause only a slight increase in the rate of tissue desiccation when compared with water-treated checks. A number of oil-containing compounds were found to decrease the rate of drying from 4 to 16 per cent when compared with shoots dipped in water. It was found that copper sulfate, when added to hydrated lime, did not stand alone in its effect in increasing the rate of tissue drying but that ferrous sulfate caused an even greater increase. Zinc sulfate, on the other hand, was not as effective as copper sulfate. When other sulfates used in an N/10 solution were compared with copper sulfate, it was found that the latter was more effective in increasing the rate of desiccation than any of the others used. Of a variety of copper compounds tested, copper chloride was the only one found to cause a greater rate of drying of Coleus leaves than did copper sulfate. In a similar experiment in which a number of sodium compounds were used, two of them, sodium chlorate and sodium sulfite, were found to be particularly effective as drying agents. Of a group of compounds sometimes used as herbicides, sodium arsenite was found to have the greatest desiccating effect and ferrous sulfate the least.

CELERY YELLOWS IN OHIO

J. D. WILSON

Celery yellows caused its first noticeable loss in Ohio celery fields in 1915, at least 5 years after it appeared in the vicinity of Kalamazoo, Michigan (1, 2). Coons described it in 1916 (1) as a disease causing a severe stunting of celery. Later he called it "yellows" and stated that it was caused by *Fusarium* sp. (3). The disease has since been reported from several localities in the northeastern portion of the United States.

The name "yellows" describes the most characteristic symptom of the disease. Affected plants appear as if blanched, the leaves often being almost white. Plants of highly susceptible varieties may be attacked at any time during their growth if environmental conditions are favorable. If small at the time of infection, the plants usually become yellow quickly and wilt and die in a short time. Secondary rots frequently destroy the roots and crown so

1. Coons, G. H. 1916. Celery diseases. Proc. Mich. Acad. Sci. 17: 126-128.
2. Nelson, R. and L. C. Cochran. 1932. "Michigan Golden", a new celery resistant to yellows. Mich. Agr. Exp. Sta. Quart. Bull. 15: 102-106
3. Coons, G. H. and R. Nelson. 1921. Celery yellows. Phytopath. 11: 54-55.

that only the detached, yellowish-brown leaves remain to mark the place where the plant stood. When a plant escapes infection until it is somewhat larger, it often does not die but persists throughout the summer as a stunted, off-color specimen. The leaf stalks of these plants are brittle and bitter to the taste. The root system is frequently seriously affected, and the crown often becomes honeycombed with cavities and may split open, exposing the reddish-brown tissue within. The vascular bundles of the root, crown, and leaf stalk usually become brown; this condition may extend even into the leaves. In some cases, affected plants may exhibit a one-sided growth, one-half only being diseased and stunted.

Fig. 1.—Loss caused by celery yellows at Celeryville, Ohio, in 1931. Six rows on left are a highly susceptible variety

Celery yellows was noticed in restricted areas in a few fields at Celeryville, Ohio, in 1915, and by 1917 had become general enough in that section to cause a considerable loss in yield. In 1917 and 1918 a number of growers who had been growing the original strain of Golden Self-blanching, a variety which has proved to be very susceptible to yellows, changed to Easy Blanching. This variety was more resistant to the disease, but, in spite of this, further losses were experienced; as a result, by 1922 to 1924 the use of a new, tall strain of Golden Self-blanching became general, when it was found that this strain was not being attacked by yellows to any appreciable extent. The culture of this variety, together with other partially susceptible ones, has continued to the present in many fields, but occasional losses were experienced in individual instances each year until 1930. During this hot, dry summer the disease was scattered throughout the Celeryville district but did not cause material losses in any field. However, in 1931, with a gradual lessening of the moisture reserve in the subsoil, yellows again became severe and many fields showed a complete loss of the crop (4). The condition in one of these fields early in August is shown in Figure 1. The tall strain of Golden Self-blanching suffered

4. Wilson, J. D. 1933. Resistance of celery varieties to yellows. Ohio Agr. Exp. Sta. An. Rept. 51, 43-44.

severely during the summer of 1931, and a number of other self-blanching and easy-blanching varieties, particularly in early-planted fields, were more or less affected. The green varieties were not noticeably diseased. The summer of 1932 was more normal, and losses were less severe. In 1933, when one especially long period of dry, hot weather occurred, many fields were again seriously affected.

The history of celery yellows in Ohio, as described above, suggests several possibilities concerning the variations in the severity of the disease from year to year; namely, the resistance of a given variety or strain of celery to the disease may decrease, the causal organism may develop in such a way that its ability to attack the host increases, or more than one strain of it may be present or new ones may evolve from the original parent. Of course, the influence of variations in temperature and rainfall on the severity of the disease during different seasons must be considered, as must also the fact that the population and distribution of the causal organism vary from year to year.

A Fusarium disease of celery closely resembling yellows and probably identical with it occurred in a very severe form in a muck area near Lodi, Ohio, in 1921 and 1922 (5). The disease persisted in a severe form in certain fields for a number of years following 1922. Celery yellows has been observed by the author in a few isolated fields in northern Ohio during nearly every one of the past 7 years.

Early in the study of this disease it was noted to be most severe during dry, hot weather (1, 6), as is the case with many of the diseases caused by a Fusarium. This relationship between the weather and the disease has been quite noticeable during the past 4 years in the fields at Celeryville (4, 7). The summer of 1930 was extremely dry in Ohio. In July the rainfall was only about 40 per cent of normal (8). In spite of this, celery yellows was not a serious disease in Ohio in 1930, partially due, no doubt, to the fact that the air and soil temperatures remained nearly normal until late July and early August, by which time much of the early celery (in which is included many of the more yellows-susceptible strains) was of good size. In 1931 yellows was, as mentioned above, very serious (see Figure 1). The moisture reserve of the subsoil had been depleted during the severe drouth of the previous summer, and the onset of dry, hot weather in late June and early July with accompanying high soil temperatures helped the disease to check severely the growth of plants infected when they were small.

The fact that a lowering of the water table increased the severity of yellows in the Kalamazoo district was mentioned by Nelson and Cochran (2). The importance of this factor in the relation between the celery plant and the disease was emphasized on one of the farms at Celeryville during the season of 1931, where nearly all of the plants set during June were diseased in a field which had been supplied with tile in the fall of 1930. The disease had not previously been severe in this field but has been ever since the water table was lowered by tiling.

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5. Thomas, R. C. 1924. A Fusarium disease of celery. Ohio Agr. Exp. Sta. Mo. Bull. 9: 88-90.
6. Coons, G. H. and R. Nelson. 1922. First progress report on "yellows-resistant" Golden Self-blanching celery. Phytopath. 12: 48.
7. Wilson, J. D. 1934. Resistance of celery varieties to yellows. Ohio Agr. Exp. Sta. An. Rept. 52, 35.
8. Wilson, J. D. 1932. Evaporation and drouth at Wooster. Ohio Agr. Exp. Sta. An. Rept. 50, 58-59.

In 1932 the average temperature during the growing season was more nearly normal than in 1931, particularly during late June and early July, and celery yellows was not as severe as in the latter year. The soil temperature at a depth of 2 inches seldom exceeded 72° F. In 1933 both June and July were exceedingly dry and warm, with the rainfall in June far below normal and the evaporation at its highest value for this month in several years. These factors, combined with soil temperatures at the 2-inch depth varying between 75 and 85° F., were favorable for the development of yellows. The disease became very severe in certain fields, with losses approaching 100 per cent, although it was not as destructive in the crop as a whole as in 1931.

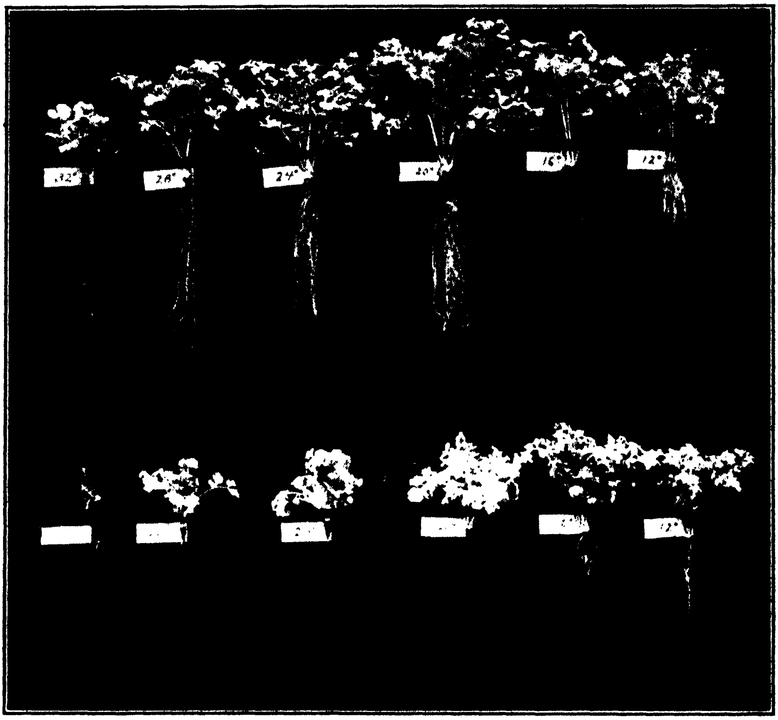

Fig. 2.—**Relation of soil temperature to the growth of Golden Self-blanching celery and to the yellows-host relation. Upper series in sterilized soil and lower in sterilized soil plus yellows inoculum.**

In an effort to determine more definitely the influence of soil temperature on the disease, four varieties of celery were grown in cans of muck soil, the temperatures of which were held constant in a series of controlled-temperature tanks. The temperatures used varied from 12° C. (54° F.) to 32° C. (90° F.) by intervals of 4° C., or 7° F. The tall strain of Golden Self-blanching was grown at each temperature in a can of soil free of the causal organism to determine the optimum temperature for the growth of the celery plant. This variety, Wonderful, Early Fortune, and Michigan Golden (2) were grown in soil to which the causal organism (*Fusarium* sp.) had been introduced from

culture. The growth of Golden Self-blanching in the two soils is shown in Figure 2, with the plants grown in the yellows-free soil represented in the upper half. The experiment was performed twice, one lot of plants being harvested on February 24 and the other on April 20. The plants shown in Figure 2 were from the latter group.

The best growth of roots and tops occurred at 20° C. (68° F.) in the second experiment, but in the first it was as good at 24° C. (75° F.) as at 20° C. Thus, the optimum growth of celery in these tank experiments occurred at a soil temperature between 20 and 24° C., probably somewhat nearer the former. The growth at 16° C. (71° F.) and 28° C. (82° F.) was comparable. It was better at 12° than at 32° C.

At 32° C. all of the Golden Self-blanching plants in the Fusarium-treated soil died within 2 weeks after transplanting. Half of the plants survived at 28° C. until the end of the experiments but failed to make much growth, and the leaves were nearly devoid of green. At 24° C. the growth condition was similar to that at 28° C. but none of the plants died. Both roots and tops grew somewhat better at 20° C. but the plants were still decidedly yellow in color. The plants at 16° C. and 12° C. were nearly normal in appearance and comparable in size to those in yellows-free soil, indicating that the disease was inactive at these temperatures. Thus, the minimum temperature for the development of the disease lies between 16° C. and 20° C. The optimum and maximum temperatures for its development could not be determined from these experiments, but, since the optimum growth of the fungus in culture was nearer 30 than 25° C., it is likely that the optimum temperature for disease development is above 28° C. and the maximum considerably above 32° C. It will be remembered that the disease was severe in the field with soil temperatures at the 2-inch level between 75 and 85° F., or 24 and 29° C. Of course the maximum temperatures were considerably above 29° C.

Michigan Golden showed some injury at 32° C., and at 28° C. it was slightly stunted and off-color. Wonderful was slightly affected at 24° C., more so at 28° C., and at 32° C. 20 per cent of the plants died, the remainder being badly diseased. Early Fortune was similar in behavior to Wonderful; some of the plants died at 28° C. and were stunted and off-color at 24° C. Thus, Golden Self-blanching was the only variety plainly showing the effects of the disease at 20° C., but, in spite of this, the check plants were larger at this temperature than in any variety growing in the cans of soil containing yellows inoculum.

During the first few years that celery yellows was observed and studied in Michigan it was noted that there was a wide variation in susceptibility to yellows in the different varieties, or strains, of celery. The green sorts were found to be much more resistant to the disease than the yellow ones, with the easy-blanching types intermediate (1, 3, 6). Thomas (5) reported the green varieties to be quite resistant at Lodi, Ohio; whereas the yellow ones were badly affected.

Coons and Nelson (6) observed that, even in fields where the disease was at its worst, a few plants of the dwarf strain of Golden Self-blanching frequently survived. From one of the survivals of 1919 a strain was selected which proved to be highly resistant. Seed of this strain was available in 1925. However, in the meantime, the tall strain of Golden Self-blanching had largely replaced the original dwarf strain (2). In 1930, after yellows had again

become bad in Michigan, selections were made from the tall strain of Golden Self-blanching, and one of these, the yellows-resistant variety now known as Michigan Golden, was developed by Nelson and Cochran (2).

In 1927 a field at Lodi, Ohio, in which losses had been severe in 1921 and 1922 (5), was planted to a number of celery varieties in an effort to determine their relative resistance to yellows. In the order of decreasing resistance they ranked as follows—Emperor (no yellows), French Emperor (none), a dwarf, curly, Michigan selection (none), Columbia (3 per cent diseased), Michigan, resistant strain of dwarf Golden Self-blanching (5 per cent diseased), Golden Plume (50 per cent diseased), the ordinary tall strain of Golden Self-blanching (80 per cent diseased), and the dwarf strain of the latter (90 per cent diseased). These results again demonstrated the yellows-resistant qualities of the green varieties when they were compared with the yellow.

The severe losses from yellows experienced by several growers in the Celeryville district in the summer of 1931 indicated the desirability of again testing a number of the available varieties for resistance to the disease. Accordingly, in the summers of 1932 and 1933, several varieties belonging in the easy-blanching and yellow groups, together with the green Columbia, were grown in two fields in which the disease had destroyed most of the plants in 1931. The results are shown in Table 1.

TABLE 1.—Comparative Resistance of Various Celery Varieties to Yellows at Celeryville, Ohio

Varieties ranked on basis of general appearance at harvest	Percentage of plants definitely affected by the disease		
	1932	1933	Average
	Per cent	*Per cent*	*Per cent*
Columbia	2.0	4.0	3.0
Michigan Golden	0.0	6.8	3.4
M. S. C. dwarf strain Golden Self-blanching	2.4		
Florida Golden		20.6	
Early Fortune	3.4	20.2	11.8
Newark Market		28.7	
Golden Prize	2.6		
Golden Plume	7.0	27.5	17.3
Wonderful No. 1	8.2	23.0	15.6
Wonderful No. 2	6.0	34.6	20.3
Tall strain Golden Self-blanching	19.6	83.0	51.3
Hoover Special	88.6	76.0	82.3
Golden Phenomenal	90.6	75.0	82.8

The high degree of resistance to yellows, together with the possession of many of the characteristics of the tall strain of Golden Self-blanching, indicates this to be a desirable variety for use in fields in which the causal organism of yellows is known to exist. On the other hand, the extreme susceptibility to the disease of the last three varieties listed in the table makes them undesirable for use in highly contaminated fields. The resistance of the green varieties, represented by Columbia, to yellows is again shown. The intermediate position and similarity of the easy-blanching varieties is indicated by their close grouping in the central portion of the table. These latter varieties often give satisfactory results (as in 1932) in fields where the disease is not too severe, except during seasons particularly favorable to the disease (such as 1933).

SUMMARY

The first observed case of celery yellows in Ohio, the causal organism of which is *Fusarium* sp., occurred at Celeryville, near Willard, in 1915. The most distinctive symptoms of the disease are the yellow, blanched appearance of the foliage and a marked checking of growth. Golden Self-blanching, which is very susceptible to yellows, was generally grown at the time the disease made its appearance but was gradually abandoned in favor of some of the more resistant, easy-blanching types. Even these showed considerable loss at times and were largely replaced a few years later by the, at that time, newly developed tall strain of Golden Self-blanching. This gave good results, with only occasional losses from yellows, until 1931. This was a dry, hot summer, very favorable to the disease, and severe losses occurred in many fields.

Experiments in which four varieties of celery were grown in soil at controlled temperatures indicated the optimum temperature for the growth of the celery plant to lie between 20 and 24° C. (68 and 75° F.). The disease was found to be active on the susceptible tall strain of Golden Self-blanching from 20 to 32° C. (68 to 90° F.). At 20° C. the plants were off-color and slightly stunted, at 28° C. (82° F.) part of them died in a few weeks, and at 32° C. all of the plants died within a period of 3 weeks after transplanting. Thus, the optimum temperature for the disease is above 28° C., with the maximum possibly several degrees higher. Symptoms of the disease were present on Wonderful and Early Fortune at 24° C. and on Michigan Golden at 28° C. At 32° C. all of the varieties showed definite injury from the disease.

Early observations made on the disease in Michigan indicated that the green varieties of celery were very resistant to it; whereas the yellow varieties were generally susceptible, with the intermediate easy-blanching varieties also intermediate in this character. Field trials of several varieties made at Celeryville in 1932 and 1933 showed Columbia, a green variety, to be very resistant. This was also true of Michigan Golden, a yellows-resistant selection made at Michigan State College from the tall strain of Golden Self-blanching. The yellow varieties Golden Self-blanching, Hoover Special, and Golden Phenomenal were very susceptible. Several varieties intermediate in characters between the true green and yellow types were more resistant than the three varieties just mentioned. They included Florida Golden, Golden Prize, Early Fortune, Newark Market, Golden Plume, and Wonderful. Michigan Golden, besides having shown a high degree of resistance to yellows at Celeryville, also possesses other good characteristics which seem to make it an excellent celery for use in fields where the disease occurs, even intermittently.

The writer wishes to acknowledge his indebtedness to the Wier Brothers and to Mr. Van Zoest, of Willard, Ohio, in whose fields the trials on varietal resistance were made.

STEM CANKER DISEASE OF GARDENIA

PAUL E. TILFORD

A stem canker disease of Gardenia occurred on the variety Millosys in a greenhouse at Cleveland, Ohio, during the winter of 1932 and 1933. These plants were originally purchased from a grower in the East, indicating that the disease is present in that section. Since that time, the same trouble has been observed on other varieties, and, recently, what is apparently the same disease (1) has been reported on several varieties of Gardenia grown in greenhouses in the San Francisco Bay Region, in California.

Under natural conditions infection apparently occurs only on the part of the stem in contact with the soil. The stem near and below the soil line becomes considerably enlarged, due to the excessive development of the cortical tissue, Figure 1. A large amount of cork forms on the outer part of the cankered area in which there are numerous longitudinal cracks. This cracked condition of the corky outer surface of the swollen canker gives it a rough and corrugated appearance. The cortical tissue below the cork, as well as for some little distance beyond the cankered area, is colored bright yellow. Even after the canker has extended all the way around the stem, the plants are slow to die. They may live for several weeks although they are more or less stunted. Lesions or cankers form on the branches following artificial inoculation with the causal fungus, but no enlargement of the cortex occurs in the case of the aerial cankers. These lesions are more or less oblong, somewhat sunken, and the cortex often cracks, exposing the wood below. The aerial lesions on the branches have not been observed, except following artificial inoculation. Apparently, the swollen stem canker at the base of the plant is by far the most common manifestation of the disease under natural conditions.

Upon close examination small, black fruiting bodies (pycnidia) of the causal fungus can be found half buried in the cortex near the point where the canker started. Under conditions of high humidity a yellowish mass of spores exudes from the fruiting bodies. These spores are splashed from one plant to another in watering, and the disease may be transmitted in this way. Two types of spores, Figure 1A, a long filiform type and an elliptic-fusiform spore, occur in the same pycnidium. This fact and the general characteristic of the fungus indicate that it belongs to the genus *Phomopsis.* Inoculation experiments have shown that neither the spores nor the mycelium of the fungus is able to cause infection except through wounds. The organism is apparently a rather weak parasite.

Since infection occurs only through wounds, care should be exercised in handling and potting the plants not to injure them. Pots and soil should be sterilized if the disease has occurred in the past. All diseased plants should be destroyed so that they will not serve as a source of infection. When small plants are purchased they should be watched closely for several weeks, and if any become diseased the affected ones should be sorted out and burned. The disease should be completely eliminated from a lot of plants before they are used as stock for cuttings.

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1. Hansen, H. N. and C. E. Scott. 1934. A canker and gall disease of Gardenia. Science (New Series) 79: No. 2036, 18.

Fig. 1.—A. Both filiform and fusiform spores of the causal fungus. X 420. B. Diseased plant, artificially inoculated. C. Naturally infected, diseased plant

DAILY VARIATIONS IN CALORIE INTAKE OF A PRE-SCHOOL CHILD

HUGHINA McKAY

In connection with a long-time study of the foods used by pre-school children, recently made in the Home Economics Department of the Ohio Agricultural Experiment Station, it seemed interesting to note daily, as well as seasonal, variations in the calorie value of the foods eaten by individual children. Of the nine children comprising the group at the beginning of the 2-year study, five were pre-nursery school children and four were nursery school children. The child whose calorie intake is discussed in this paper was the youngest of the nursery school children in the group, a girl 26 months old at the beginning of the study.

The data for this child are of special interest in that she seemed perfectly normal in her reaction to food, came to each meal with a good appetite, and ate without comment but with seeming enjoyment the foods which were provided her, had second helpings frequently, and did not dawdle over her meals. On only one occasion during the 56 days on which her food intake was observed did she seem reluctant to eat a food served. In addition, her average daily variation in calorie intake for the entire period of the study was the lowest of the group.

TABLE 1.—Daily Variations in Calorie Intake of a Pre-school Child First Year

Season	Day of week	Total calories	Percentage of total calories	
			Milk	Fruits and vegetables
Winter	1. Monday	1464	32	27
	2. Tuesday	1263	25	28
	3. Wednesday	1239	38	19
	4. Thursday	1182	36	30
	5. Friday	1303	33	17
	6. Saturday	878	35	13
	7. Sunday	1334	32	18
	Average	1238	33	22
Spring	1. Saturday	1265	45	9
	2. Sunday	1473	36	12
	3. Monday	1462	44	14
	4. Tuesday	1382	43	6
	5. Wednesday	1576	30	27
	6. Thursday	1434	43	9
	7. Friday	1423	42	27
	Average	1431	40	15
Summer	1. Tuesday	1404	40	17
	2. Wednesday	1399	37	23
	3. Thursday	1272	49	16
	4. Friday	1188	52	20
	5. Saturday	1159	43	23
	6. Sunday	1172	60	8
	7. Monday	1487	50	7
	Average	1297	47	16
Autumn	1. Saturday	1188	45	10
	2. Sunday	1364	37	14
	3. Monday	1159	41	15
	4. Tuesday	1247	51	10
	5. Wednesday	1140	41	20
	6. Thursday	1232	46	10
	7. Friday	1296	36	19
	Average	1232	42	14

Table 1 shows this child's daily calorie intake for a week of the study for each season of the first year. In addition, the percentage of total calories derived from milk and from fruits and vegetables for each day of the study is given. Table 2 gives corresponding data for the second year. Table 3 gives the maximum and minimum calorie intake for each week and the percentage difference as based on the smallest intake.

TABLE 2.—Daily Variations in Calorie Intake of a Pre-school Child Second Year

Season	Day of week	Total calories	Percentage of total calories	
			Milk	Fruits and vegetables
Winter	1. Thursday	1499	34	31
	2. Friday	1598	30	25
	3. Saturday	1326	37	28
	4. Sunday	1216	34	22
	5. Monday	1458	43	25
	6. Tuesday	1169	44	15
	7. Wednesday	1358	39	21
	Average	1375	37	24
Spring	1. Monday	1675	39	30
	2. Tuesday	1594	40	23
	3. Wednesday	1460	37	24
	4. Thursday	1454	42	21
	5. Friday	1468	27	47
	6. Saturday	1308	29	31
	7. Sunday	1547	35	15
	Average	1501	35	27
Summer	1. Wednesday	1229	42	24
	2. Thursday	1000	36	31
	3. Friday	1442	31	40
	4. Saturday	1289	40	25
	5. Sunday	1094	41	21
	6. Monday	1240	48	23
	7. Tuesday	1341	56	17
	Average	1234	42	26
Autumn	1. Tuesday	1241	42	18
	2. Wednesday	1373	33	24
	3. Thursday	1471	33	22
	4. Friday	1167	28	29
	5. Saturday	1168	34	28
	6. Sunday	1266	36	29
	7. Monday	1565	35	24
	Average	1321	35	25

The variation in calorie intake of this child who seemed perfectly normal in every respect in her food habits was quite marked for each week—ranging from 20 to 67 per cent, with an average of 35 per cent for the entire period of the study. This average variation is considerably below the average of 49 per cent for 52 adolescent girls whose calorie intake for a week's period was reported by Wait and Roberts[1]. Thirty-four of these adolescent girls had daily variations in calorie intake ranging from 35 to 181 per cent; 18 had corresponding variations of 35 per cent or less. Presumably, pre-school children are more closely supervised in regard to their food habits than are older children, and one would expect their calorie intake to vary less from day to day.

Reasons for such variations in the calorie intake of normal children are hard to find. Probably a number of factors operates.

[1]Wait, B. and L. J. Roberts. 1932. Daily variations in energy intake of the individual. Jour. Am. Diet. Assoc. 8: 323.

One factor which undoubtedly influences the amount of food a child consumes is the regularity with which the meals are eaten. During the first week that this pre-school child's diet was observed, her lowest calorie intake, 878, came on Saturday. Her highest calorie intake, 1464, came on Monday, making a difference of 586 calories between the two, or 67 per cent as based on the lowest intake. On the day of low calorie intake the child, ordinarily up earlier to attend nursery school, slept until almost lunch time and ate only two meals. Her low calorie intake of that day may illustrate the fact that regularity of health habits, such as time of going to bed and of getting up in the morning, are important factors in determining the amount of food a child eats and that few persons can change their habits in regard to amounts of food eaten at a meal to such an extent that as much food is eaten at two meals as would have been eaten in three.

In addition to having only two meals that day, the child had a cold and the depressing influence of a cold on the appetite is well known. On no other day of the entire study did her calorie intake drop as low.

Overfatigue is often responsible for reduction in the calorie intake of pre-school children. During 6 of the 8 weeks that her food intake was observed, the child had her noon meal at the nursery school from Monday through Friday. The nursery school routine includes a rest for each child immediately preceding the noon meal, little distraction from the main purpose of the meal while the children are at the table, and the long rest of the afternoon immediately following the meal.

Highest weekly calorie intakes for 5 of the 6 weeks during which the child was in the nursery school were on school days. Three of these 5 days of highest calorie intake were on Monday, one on Tuesday, and one on Friday. For 3 of the 5 weeks, the day of lowest calorie intake came on Saturday.

During this period her average daily calorie intake for school days was 1376, as compared to a corresponding calorie intake for the week-ends of 1269, a difference of 107 calories or 8 per cent. For this child, at any rate, the nursery school routine was favorable to higher calorie intakes.

Disregarding nursery school attendance, for 6 of the 8 weeks of the study the highest food intakes were during the first 3 days of the week, Sunday, Monday, and Tuesday; whereas, for the other 2 weeks, the highest intakes were on Friday. Lowest intakes for 6 of the 8 weeks are recorded for the last 3 days of the week, Thursday, Friday, and Saturday. Whatever the reason, the first part of each week seemed more favorable for higher food intakes than the latter part of the week.

TABLE 3.—Maximum and Minimum Calorie Intake

	Season	Maximum	Minimum	Difference	Percentage difference
First year	Winter	1464	878	586	67
	Spring	1576	1265	311	25
	Summer	1487	1159	328	28
	Autumn	1364	1140	224	20
Second year	Winter	1598	1169	429	37
	Spring	1675	1308	367	28
	Summer	1442	1000	442	44
	Autumn	1565	1167	398	34

The amount of milk used has been shown in some cases to have a decided effect on the total calorie value of the diets eaten[2]. One might expect the use of fruits and vegetables to exert some influence also. Tables 1 and 2 show the percentage of total calories derived from each of these two food groups for each week of the 2-year period. Using the data from these tables, the median calorie intake for each week was found and the relation of number of calories derived from milk and also from fruits and vegetables to this arrangement of calories was noted.

For 7 of the 8 weeks of observation, the days on which the largest percentage of calories was derived from milk were the days of highest calorie intakes for the week. The use of milk in liberal amounts by this child was, therefore, associated with the higher calorie intakes of the period.

This was also true in regard to fruits and vegetables. The days of liberal use of fruits and vegetables, as indicated by the percentage of total calories derived from these foods, were the days of the higher calorie intakes of the week.

Activity may be assumed to influence calorie intake, perhaps in two different ways. Food need certainly is increased through increased activity, but excessive activity may lead to overfatigue, which in turn may depress the appetite and thereby decrease food intake. With easily stimulated young children great care must be exercised to avoid overstimulation and excessive fatigue. The little girl of this study, however, seemed very placid, was not easily overexcited, and as far as the observations extended seemed not to vary her activity greatly from day to day.

For this girl the highest calorie intake came in the spring of each year. For the second year, this period of highest calorie intake was associated with the lowest variation in daily calorie intake for the year. During the first year the week of highest calorie intake was the week of second to lowest daily variation. There is a possibility that uniformity in daily calorie intake is conducive to a higher average calorie intake, but the evidence for this is not very conclusive.

As far as data collected for this child and others of the group may be taken as evidence, considerable variation in the calorie intake from day to day is quite normal for pre-school children.

[2]Rose, M. S. 1933. The foundations of nutrition, revised edition. MacMillan Company.

SOME NOTES ON MARKETING LIVESTOCK BY TRUCK

GEO. F. HENNING

(The following article is a summary of some additional information obtained in the study which has been published in Ohio Experiment Station Bulletin 531, "Motor Transportation of Livestock in Ohio").

A phase connected with the origin of livestock and the distance trucked to terminal markets is the time of arrival at markets. This information is given in Tables 1 to 4. A comparison is made between winter and summer for different mileage zones. All livestock that was unloaded after 3:00 P. M. was considered as held for the next day's market.

In comparing the two zones under 50 miles and 50 to 75 miles most of the livestock was unloaded between 9:00 A. M. and noon. Very little was trucked in at night for sale the next day. Only during January, for the zone under 50 miles, in the case of hogs was any considerable percentage moved at night. This was due mainly to one locality where the truckers no doubt preferred to load up in the afternoon, arrive at market late in the afternoon, and return home the same evening. The analysis indicates that the truckers arrived about an hour earlier during July than during January. A very small percentage of livestock arrived after noon during the summer.

When the time of arrival is examined for the zone 75 to 100 miles from Cleveland, a tendency is noted to move more livestock at night. More than 20 per cent of the livestock arrived during January before 5:00 A. M. and over 25 per cent during July. This would seem to indicate that some truckers prefer to move livestock the night before when the distance approximates 100 miles. However, the bulk of the livestock continued to arrive between the hours of 9:00 in the morning and 1:00 in the afternoon.

Those truckers moving livestock more than 100 miles arrived with the bulk of their loads during the night. In the case of the hogs for the 100- to 125-mile zone, more than 50 per cent arrived during the night or before 5:00 in the morning. Approximately the same percentages held for the other species. However, with cattle, calves, and sheep a much larger percentage arrived at night during July than during January. For hogs there was no difference between January and July when compared for night delivery. For sheep nearly 87 per cent was delivered at night during July and only 42 per cent during January for the zone 100 to 125 miles from Cleveland. The percentages for calves were 70 and 45 for July and January, respectively.

For the zone 125 miles and over the common practice was to load the day before and drive at night. The data show that more than 75 per cent of the livestock came in at night. Upon examining the figures more closely one observes that from 20 to 30 per cent of the receipts from the more distant points arrived between the hours of 5:00 and 8:00 in the morning, which would indicate that the truckers were on the road all night, for most truckers aim to have livestock loaded before dark.

There was no outstanding tendency to deliver more livestock at night during the summer as compared to winter. If a trucker delivered at night during the summer, he no doubt followed the same practice during the winter. There was a definite tendency to arrive earlier at the market during summer than during winter for those points less than 100 miles from Cleveland.

TABLE 1.—Cattle: The Time of Arrival by Truck at Cleveland, by Mileage Zones, for January and July, 1932
(In Percentage)

Time of arrival	Under 50 miles		50—74.9 miles		75—99.9 miles		100—124.9 miles		125 miles and over		Total	
	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July
3— 3:59 P. M.	3.7	....	0.3	....	1.5	0.6	....	2.7	....	4.2	1.3	1.4
4—11:59 P. M.	3.8	2.0	3.4	4.6	12.2	7.4	28.2	30.7	21.4	16.2	10.3	11.9
12— 4:59 A. M.	0.8	2.8	4.0	5.5	9.2	18.5	23.7	38.3	38.2	44.7	10.7	20.4
5— 7:59 A. M.	1.7	7.2	6.1	7.4	6.3	11.8	18.2	7.1	31.3	24.1	9.6	10.8
8— 8:59 A. M.	5.4	22.6	14.4	27.3	13.7	12.0	14.8	3.7	2.2	3.3	10.4	15.2
9— 9:59 A. M.	24.9	34.9	22.5	19.4	14.3	17.2	10.7	5.3	2.5	2.8	17.9	16.0
10—10:59 A. M.	25.9	17.4	21.6	20.6	19.6	16.1	0.3	1.9	1.1	0.3	17.2	12.1
11—11:59 A. M.	18.2	9.2	17.5	8.9	8.0	9.1	1.0	2.5	3.3	1.2	12.4	6.3
12—12:59 P. M.	13.5	2.3	9.1	4.3	8.3	4.8	0.7	1.0	....	3.2	8.0	3.2
1— 1:59 P. M.	1.5	0.8	0.4	0.4	3.9	1.8	2.4	0.8	....	....	1.4	0.7
2— 2:59 P. M.	0.5	0.8	0.7	1.6	3.0	0.7	....	6.0	....	....	0.8	2.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 2.—Calves: The Time of Arrival by Truck at Cleveland, by Mileage Zones, for January and July, 1932

(In Percentage)

Time of arrival	Under 50 miles		50—74.9 miles		75—99.9 miles		100—124.9 miles		125 miles and over		Total	
	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July
3— 3:59 P. M.	1.3	2.6	0.4	0.7	2.3	1.0	....	....	0.7	0.4	1.0	1.0
4—11:59 P. M.	....	9.0	2.5	4.8	17.1	13.7	15.3	15.9	20.8	12.5	7.0	9.4
12— 4:59 A. M.	1.3	4.9	2.6	7.2	8.2	20.3	29.8	54.5	44.9	41.8	7.9	18.1
5— 7:59 A. M.	8.7	10.1	12.8	15.1	3.5	7.0	10.2	10.1	27.2	29.1	11.0	15.0
8— 8:59 A. M.	12.8	23.0	17.1	22.9	6.2	10.1	18.5	4.9	2.7	2.7	12.7	15.8
9— 9:59 A. M.	25.5	25.2	18.3	12.5	11.0	15.5	17.5	3.5	0.8	1.3	16.9	13.2
10—10:59 A. M.	22.5	14.7	21.0	17.6	20.4	19.1	1.8	4.1	1.0	0.3	18.9	13.3
11—11:59 A. M.	18.8	7.0	13.9	11.6	17.9	8.3	3.6	4.1	1.5	4.4	14.5	8.2
12—12:59 P. M.	5.5	2.0	7.5	6.4	9.2	3.6	1.1	2.9	0.2	0.2	6.6	3.6
1— 1:59 P. M.	2.3	1.5	2.6	0.9	2.3	1.4	2.2	....	....	3.9	2.2	1.7
2— 2:59 P. M.	1.3	....	1.3	0.3	1.9	....	....	....	0.2	3.4	1.3	0.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 3.—Hogs: The Time of Arrival by Truck at Cleveland, by Mileage Zones, for January and July, 1932
(In Percentage)

Time of arrival	Under 50 miles		50—74.9 miles		75—99.9 miles		100—124.9 miles		125 miles and over		Total	
	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July
3— 3:59 P. M.	.....	.....	1.4	.....	1.6	0.1	.....	.....	2.0	.....	1.3	0.1
4—11:59 P. M.	18.3	6.8	4.7	3.3	6.8	5.1	32.8	9.4	16.0	2.9	14.6	5.0
12— 4:59 A. M.	6.0	.....	3.1	5.7	12.8	14.0	20.0	43.4	53.8	72.0	23.0	23.1
5— 7:59 A. M.	2.7	9.5	4.5	9.2	9.8	4.7	9.2	5.4	19.0	18.9	10.8	9.2
8— 8:59 A. M.	8.1	25.7	6.9	20.6	9.1	13.7	9.6	19.3	4.1	1.0	7.4	15.7
9— 9:59 A. M.	18.2	31.6	13.8	18.7	12.4	23.4	6.8	11.5	2.2	0.5	9.2	18.4
10—10:59 A. M.	13.1	18.5	26.8	17.5	11.4	22.5	8.7	5.8	1.2	1.7	10.9	15.1
11—11:59 A. M.	24.3	5.8	17.8	18.0	22.8	11.5	6.4	4.0	1.7	1.2	13.3	9.4
12—12:59 P. M.	6.6	1.6	16.1	4.6	10.5	3.0	4.1	1.2	.....	0.7	7.2	2.5
1— 1:59 P. M.	2.1	0.5	3.7	2.4	2.0	1.9	2.4	.....	.....	1.1	1.8	1.4
2— 2:59 P. M.	0.6	.....	1.2	.....	0.8	0.1	.....	.....	.....	.....	0.5	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 4.—Sheep: The Time of Arrival by Truck at Cleveland, by Mileage Zones, for January and July, 1932

(In Percentage)

Time of arrival	Under 50 miles		50—74.9 miles		75—99.9 miles		100—124.9 miles		125 miles and over		Total	
	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July
3— 3:59 P. M.	....	....	1.1	....	3.3	0.9	....	....	0.7	1.5	1.3	0.6
4—11:59 P. M.	2.3	2.9	3.8	....	4.0	13.6	20.1	2.0	21.3	17.8	9.0	8.5
12— 4:59 A. M.	7.5	1.3	3.3	1.7	12.0	10.2	22.2	84.9	44.1	39.5	15.0	18.3
5— 7:59 A. M.	0.4	6.3	2.7	4.1	9.5	5.1	17.3	8.2	22.5	25.8	9.4	10.4
8— 8:59 A. M.	2.7	18.5	14.4	15.8	10.3	9.4	14.1	1.1	5.9	2.9	11.0	10.3
9— 9:59 A. M.	19.0	31.6	15.2	16.5	12.8	20.7	16.8	0.5	1.0	8.0	13.2	16.2
10—10:59 A. M.	34.9	24.6	28.7	23.9	20.9	20.8	1.1	....	1.2	....	18.8	15.7
11—11:59 A. M.	25.6	11.5	19.9	24.5	14.4	12.1	5.9	3.3	1.1	3.1	14.0	13.1
12—12:59 P. M.	6.4	1.9	7.4	8.5	10.4	4.5	1.3	....	1.3	1.3	6.1	4.4
1— 1:59 P. M.	0.8	1.4	2.5	5.0	1.5	2.7	1.2	....	....	0.1	1.5	2.5
2— 2:59 P. M.	0.4	....	1.0	....	0.9	....	....	....	0.9	....	0.7	....
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

This analysis of time of arrival points out another difficulty which trucking has emphasized in recent years. A considerable portion of the livestock (30 to 40 per cent) arrives after 10:00 in the morning. This means that buyers and sellers must estimate late truck arrivals when the market is made earlier in the morning. Although the market news reporters can generally estimate rather accurately this late movement, there are times when unusually heavy runs arrive after 10:00 in the morning. At times such situations have a weakening influence on the market with resulting dissatisfaction and disappointment from livestock consigners and shippers. The desire was expressed generally by the truckers to be on the market rather early, at least before 10:00 in the morning. If this policy is followed, weakening prices will be avoided if caused by a heavy truck movement later in the morning. As trucking becomes more and more established in a commmunity, the custom and habits of truckers become established, with more uniformity of performance as compared to previous days and weeks. This is largely the basis upon which supply receipts by truck are forecast, taking into consideration the conditions of the market.

PREFERENCE IN MARKETING LIVESTOCK BY TRUCK

A phase of marketing which is closely associated with livestock trucking is the preference of farmers in marketing their livestock, because, as the preferences vary, the performance will likely vary.

In this study the preference of farmers was obtained from 115 men in the four areas, in order to get their point of view on trucking. This information is given in Table 5.

TABLE 5.—The Preference of Farmers in Marketing Their Livestock

Preference	Crawford	Logan	Preble	New London	Total
			Number of farmers		
Sell on the farm	12	8	7	3	30
Truck to terminal market:					
(a) Private com. firm	7	3	10	4	24
(b) Coop. com. firm	4	4	10	5	23
Market cooperatively	4	14	....	....	18
Other method*	4	7	8	1	20
Total	31	36	35	13	115
			Percentage of farmers		
Sell on the farm	38.7	22.2	20.0	23.1	26.1
Truck to terminal market:					
(a) Private com. firm	22.6	8.3	28.6	30.8	20.9
(b) Coop. com. firm	12.9	11.1	28.6	38.4	20.0
Market cooperatively	12.9	38.9	....	....	15.6
Other method*	12.9	19.5	22.6	7.7	17.4
Total	100.0	100.0	100.0	100.0	100.0

*Such as selling to local killers, market whichever way will make the most money, ship individually, etc.

This table shows that 40 per cent of the farmers interviewed prefer to market by truck. This varied, of course, in the different areas. The New London and Preble areas showed the highest preference for trucking and the

Logan territory the lowest. It will be recalled that the Logan area is essentially in the rail shipping area with only a limited amount of trucking to the terminal markets, but even in this territory 20 per cent preferred to market by truck.

It is interesting to note that of the farmers interviewed more than one-fourth preferred to sell on the farm. They like the method of knowing what they will receive before the livestock leaves the feed lots.

In the Crawford and Logan areas a number of farmers desired to market through cooperative associations. In these two areas cooperative marketing associations were active; in the other two the only cooperative service available was to truck to a cooperative commission firm. In the combined percentage of the four areas, 35 per cent of the farmers indicated a preference for marketing cooperatively; this is probably higher than the actual performance, although in Preble County in 1931, of the receipts which went to the Cincinnati market, about 30 per cent went through the cooperative commission association. Such comparisons were not available for the other areas.

A considerable percentage preferred other methods in marketing, such as selling to local killers and any other way that would bring the most money. This last group would surely fall in the "shopper" class.

It is interesting to break this group into two parts: one, those farmers who were members of some farm organization, such as the Grange or Farm Bureau and a cooperative association; and, two, those farmers who were non-members, Table 6. In our interviews we visited more farmers who were farm organization-minded, for 56 per cent was attached or connected with some form of organized agriculture. Of this number nearly half gave a preference for marketing through cooperative channels. In fact, of all the 115 farmers interviewed, only 35 gave a preference to cooperative marketing and 31 of the 35 were connected with some form of organized agriculture.

This analysis has been carried somewhat farther in Table 7. The previous discussion merely pointed out their preferences but Table 7 gives their performance for the year 1931 according to preference groups; that is, from the previous table there were 10 farmers who were members and 19 farmers who were non-members that preferred to sell their livestock on the farm. In looking at Table 7 we see that these 10 members actually sold 91.5 per cent of their livestock at the farm while the non-members sold only 70.2 per cent at the farm. In most instances these farmers marketed their livestock very much as they indicated their preference.

TABLE 6.—The Preference in Marketing Their Livestock of Farmers Who Were Members of a Farm Organization and / or a Cooperative Association and Non-members

Preference	No. of farmers		Percentage of farmers	
	Members	Non-members	Members	Non-members
Sell on farm	10	19	15.6	37.3
Truck to terminal market:				
(a) Private commission firm	12	15	18.8	29.4
(b) Coop. commission firm	16	2	25.0	3.9
Ship cooperatively by rail	15	2	23.0	3.9
Other methods*	11	13	17.2	25.5
Total	64	51	100.0	100.0

*Such as sell where one can get the most money, to local killers, ship to terminals themselves, etc.

This table further shows that the cooperatives were not getting very much business from groups except those preferring to go cooperatively. Likewise, the private commission firms were getting a larger percentage of their business from farmers who preferred to truck to them.

TABLE 7.—The Percentage of Livestock Marketed Through Different Channels by Farmers According to Preference Groups,* 1931

Preference	Method of marketing in 1931					
	Sold on the farm	Trucked to terminal market		Coop. by rail	Other methods	Total
		Private com. firm	Coop. com. firm			
Sell on the farm:						
Members	91.5	4.8	3.7	....	....	100.0
Non-members	70.2	15.9	5.0	0.9	8.0	100.0
Truck to terminal market:						
(a) Private com. firm:						
Members	23.1	65.2	0.6	4.7	6.4	100.0
Non-members	0.7	85.0	....	3.1	11.2	100.0
(b) Coop. com. firm:						
Members	0.1	0.4	91.3	5.4	2.8	100.0
Non-members	2.0	16.0	82.0	....	....	100.0
Cooperative by rail:						
Members	1.3	1.6	7.2	87.5	2.4	100.0
Non-members	....	....	....	100.0	....	100.0

*Who are members or non-members of farm organizations and / or cooperative organizations.

Another question which is closely related to that of performance in marketing is "Who decides where the livestock shall be consigned, especially when it is trucked to a terminal market?" Of the farmers who furnished information, 60 per cent said that the farmer decided; whereas 40 per cent declared the decision was left to the trucker. There was considerable difference between areas—for example, in Preble County the farmers (100 per cent of farmers giving information) decided where the livestock was to be consigned; whereas in Crawford the truckers decided where the livestock was consigned, for only 20 per cent of the farmers declared they decided.

This points out the fact that in some localities the trucker is more than just a transportation service. He helps or does decide marketing questions. His contact with the market during every trip soon puts him in the position where his advice (if he is the right kind of trucker) is sought by the farmers, especially those who have had little contact with livestock markets.

Since about 40 per cent of the farmers interviewed preferred to truck their livestock to a terminal market, another question was discussed; namely, "Can the farmer afford to pay any more to truck his livestock than ship by rail?" Of those answering (approximately 70 per cent of the total) nearly 80 per cent stated that a farmer could afford to pay more. The farmers were more favorable to the truck in the Preble and New London areas than in the other two. Those who indicated they could pay more gave as the more important reasons: One can market any day he selects, he can often avoid losses from disease (such as cholera epidemics), and if the market looks good or bad he can market quickly or hold a day or two longer. Those that stated they could not afford to pay any more gave as the principal reason that a farmer must market as cheaply as possible in these times.

About 50 per cent of those farmers who indicated they could pay more to truck livestock stated they could pay 5 to 10 cents more per hundredweight. One farmer ventured he could pay as much as 15 cents more. This would indicate that some farmers rate marketing livestock by truck as somewhat more desirable than marketing by rail and would even pay extra for such service.

ATTITUDE OF FARMERS AND TRUCKERS TO TRUCK OPERATION

A situation or condition which may be satisfactory to certain groups may not be satisfactory to some other group, for often those factors which may make for satisfaction to the one group are the very ones which cause dissatisfaction to others. Motor transportation of livestock is no exception to such a situation.

It was found in this study that more than 95 per cent of the farmers were entirely satisfied with the present condition of livestock trucking. Many wondered how the truckers were able to offer the trucking service at such low rates. Little, if any, dissatisfaction was found with the truckers. There is no doubt that the truckers have the good will of the livestock farmers.

TABLE 8.—The Suggestions Offered by Truckers for the Betterment of Livestock Trucking

	Crawford	Logan	Preble	New London	Total
			Number		
Set standard rates	5	1	7	....	13
Truckers cooperate and set rates	....	....	5	....	5
Enforce P. U. C. O. or do away with it	5	4	....	1	10
Lower yardage and commission rates	8	2	....	....	10
Discard old rattle-trap trucks	....	....	7	....	7
Other suggestions*	2	3	3	1	9
Total	20	10	22	2	54
			Percentage		
Set standard rates	25.0	10.0	31.8	....	24.1
Truckers cooperate and set rates	....	....	22.7	....	9.3
Enforce P. U. C. O. or do away with it	25.0	40.0	....	50.0	18.5
Lower yardage and commission rates	40.0	20.0	....	....	18.5
Discard old rattle-trap trucks	....	....	31.8	....	13.0
Other suggestions*	10.0	30.0	13.7	50.0	16.6
Total	100.0	100.0	100.0	100.0	100.0

*Other suggestions such as limit number of truckers, improve roads, get rid of community sales, bigger equipment, raise license fees of trailers, raise license fees so that old rattle-trap trucks cannot afford to get them, lower license fees, take big freight trucks off the road.

From the standpoint of the trucker, a slightly different picture is presented, Table 8. One-third of the suggestions offered was concerned with the establishment of some kind of uniform rate. There were different suggestions and ideas with respect to this question and considerable difference as far as localities were concerned. Another 18 per cent of the suggestions offered was

connected with the P. U. C. O.[1] requirements. Those truckers believed the P. U. C. O. requirements should either be enforced, or else their operation should be thrown overboard as far as livestock trucking was concerned. In fact, there was the general tendency to disregard the law entirely with respect to livestock trucking. Some of the truckers believed with the proper kind of P. U. C. O. operation, rates could be standardized and more uniformity obtained, resulting in better satisfaction to farmers as well as truckers.

Other suggestions made were as follows: Lower yardage and commission rates at the terminal stockyards (since this study was made these rates were lowered), elimination of the old "rattle-trap" trucks, limitation of the number of truckers, change in license fees, etc. These suggestions point out the fact that "all is not well" with the livestock truckers. There are many aspects which could be improved and would be desired by both truckers and farmers.

On the other hand, slightly more than 40 per cent of the farmers believed that present regulation of livestock trucks, which in reality is no regulation, is all right as it was in 1932. About 50 per cent believed that more regulation would prove beneficial if it were to be of the right kind. This is, of course, the difficulty. What regulation is of the right kind? What is reasonable and sensible? What is practical? What kind would be accepted and enforced by the public generally and those engaged in transportation?

The farmers generally appreciated the influence of motor trucks on the railroads. About 10 per cent believed that the railroads should be limited to long hauls; another 17 per cent believed that poor service of the railroads in some respects, along with the railroad rates, which were thought to be too high, were the main causes of the predicament of the railroads. The remaining farmers believed that truck competition had severely affected the business of the railroads but did not see that anything could be done to prevent it.

Very little enthusiasm was evident among the farmers for taxing the trucks more than at present. Only one-third indicated that trucks should be taxed more and 10 per cent believed they were taxed too much; the balance thought the trucks were taxed enough at present.

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[1]In Ohio every truck operator, who is acting as a common carrier. is expected to obtain an operating permit based on public necessity. This is obtained through application to the Public Utilities Commission of Ohio—hence, the abbreviation P. U. C. O.—with resulting hearings, etc. If the Utilities Commission believes public necessity demands another trucker, a permit is issued. Certain requirements are demanded, such as publishing and filing of rates, keeping records, furnishing reports to the Commission, etc.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

February saw a substantial rise in the index of farm product prices. The greater part of this rise was in livestock and livestock products. In the month of February the income to Ohio farmers from sales of products was 20 per cent above that of February 1933. From November to March there was a gradual improvement in business activity.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U.S.	Weekly earnings N.Y. State factory workers	Prices paid by farmers for commodities bought U.S.	Farm products prices U.S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	......	100	100	104	100	105	101
1914	99	100	101	102	102	102	105	108
1915	102	101	106	100	103	107	106	111
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	199
1918	192	160	178	200	175	131	203	240
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	226
1921	142	203	156	116	164	134	132	130
1922	141	197	152	125	145	124	127	130
1923	147	214	153	135	166	122	134	144
1924	143	218	154	134	165	118	133	146
1925	151	223	159	146	165	110	159	174
1926	146	229	156	136	170	105	155	177
1927	139	231	154	131	173	99	147	165
1928	141	232	156	139	169	96	154	156
1929	139	236	155	138	169	94	151	165
1930	126	226	146	117	154	90	128	133
1931	107	207	129	80	120	82	89	95
1932	95	178	110	57	92	70	63	70
1933	96	171	108	63	74	59	69	77
1932								
January	98	191	115	63	100	......	69	73
February	97	189	114	60	......	......	64	65
March	96	189	112	61	......	70	64	69
April	95	183	111	59	94	......	64	66
May	94	177	109	56	......	......	61	67
June	93	174	108	52	......	......	59	67
July	94	171	107	57	90	......	63	72
August	95	172	107	59	......	......	66	80
September	95	177	106	59	......	......	64	74
October	94	177	105	56	84	......	61	73
November	93	171	104	54	......	......	61	73
December	91	170	103	52	......	......	60	63
1933								
January	89	164	102	51	75	......	55	64
February	87	164	101	49	......	......	53	59
March	88	163	100	50	......	59	53	56
April	88	165	101	53	70	......	59	63
May	92	169	102	62	......	......	71	79
June	95	172	103	64	......	......	70	77
July	100	176	105	76	73	......	83	99
August	102	176	112	72	......	......	79	94
September	103	179	116	70	......	......	79	86
October	103	177	116	70	77	......	78	89
November	104	175	116	71	......	......	77	87
December	103	176	116	68	......	......	71	74
1934								
January	105	179	116	70	70	......	70	71
February	107	......	118	76	......	......	77	71

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

Bulletin 530. Ohio Agricultural Statistics, 1932, by A. R. Tuttle, R. E. Straszheim, and P. P. Wallrabenstein. This bulletin contains preliminary county estimates of the acreage, yield per acre, and total production of corn, winter wheat, oats, tame hay, and potatoes for 1932 and revised county estimates of winter wheat for the years 1929, 1930, and 1931. There are also included preliminary county estimates of the numbers of livestock on farms January 1, 1933.

Bulletin 531. Motor Transportation of Livestock in Ohio, by G. F. Henning. Because the past decade has shown a very large increase in the receipts of livestock by truck at terminal markets, this study of four typical, livestock sections of Ohio was made to determine the type of trucks used, the kind of truckers operating, type of loads, origin and destination of livestock, handling and insurance, and costs.

Bulletin 532. Fifty-second Annual Report. In addition to a general report of Station work under present conditions, special days, publications, library, and finances, the report contains brief summaries of selected experiments from each of the ten departments. Agronomic experiments reported include effect of soil reaction on availability of fertilizers, of fertilizers on the flora of permanent pastures, of soil type on yield of wheat, and of the dry method of legume inoculation, variety and rate-of-seeding tests with corn, alfalfa, and soybeans, and lawn experiments. New methods and materials for control of insect pests and diseases of fruits, vegetables, field crops, and ornamental trees, together with breeding of resistant varieties, are noted. The Horticulture Department reports cultural, fertilization, breeding, and environmental tests with fruits, flowers, vegetables for gardens, greenhouses, and muck, and potatoes. Nutritional, management, and disease studies are reported for dairy cattle, beef cattle, sheep, swine, and poultry, together with small-animal experiments. Studies on food habits and development of preschool children, basal metabolism of women, and azo dyes are reported by the workers in Home Economics. Economic studies of farm enterprises, taxation, and population, engineering studies on improved and new equipment, drainage, and irrigation, and the work of the District and County Farms are included. The Department of Forestry reports the emergency conservation work in Ohio, erosion control, reforestation, and forest classification. Weather summaries for the year are given.

Schedule of Special Days

1934

Poultry Day - - -	June 22
Washington County Truck Farm Field Day -	July 7
Dairy Day - -	August 10
Orchard Day -	August 17